Contents

Foreword

This application protocol has been developed under the auspices of the U.S. Air Force PDES Application Protocol Suite for Composites Program.The International Organization for Standardization (ISO) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75% of the member bodies casting a vote.

International Standard ISO 10303-222 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC4, *Industrial data and global manufacturing languages*.

ISO 10303 consists of the following parts under the general title Industrial automation systems and integration - Product data representation and exchange:

— Part 1, Overview and fundamental principles;

— Part 11, Description methods: The EXPRESS language reference manual;

— Part 21, Implementation methods: Clear text encoding of the exchange structure;

— Part 22, Implementation methods: Standard Data Access Interface;

— Part 31, Conformance testing methodology and framework: General concepts;

— Part 41, Integrated generic resources: Fundamentals of product description and support;

— Part 42, Integrated generic resources: Geometric and topological representation;

— Part 43, Integrated generic resources: Representation structures;

— Part 44, Integrated generic resources: Product structure configuration;

— Part 45, Integrated generic resources: Materials;

— Part 46, Integrated generic resources: Visual presentation;

— Part 47, Integrated generic resources: Shape tolerances;

— Part 49, Integrated generic resources: Process structure and properties

— Part 101, Integrated application resources: Draughting;

— Part 104, Integrated application resources: Finite Element Analysis;

— Part 201, Application protocol: Explicit draughting;

— Part 202, Application protocol: Associative draughting;

— Part 203, Application protocol: Configuration controlled 3D design of mechanical parts assemblies;

— Part 204, Application protocol: Mechanical design using boundary representation;

— Part 207, Application protocol: Sheet Metal Dies and Blocks.

Annexes A, B, C, D, and E form an integral part of this part of ISO 10303. Annexes F, G, H, J, and K are for information only.

The reader may obtain information on the other Parts of ISO 10303 from the ISO Central Secretariat.

Introduction

ISO 10303 is an International Standard for the computer-interpretable representation and exchange of product data. The objective is to provide a neutral mechanism capable of describing product data throughout the life cycle of a product, independent from any particular system. The nature of this description makes it suitable not only for neutral file exchange, but also as a basis for implementing and sharing product databases and archiving.

This International Standard is organized as a series of parts, each published separately. The Parts of ISO 10303 fall into one of the following series: description methods, integrated resources, application protocols, abstract test suites, implementation methods, and conformance testing. The series are described in ISO 10303-1. This part of ISO 10303 is a member of the application protocol series.

This part of ISO 10303 specifies an application protocol that defines the context, scope and information requirements for the exchange of information necessary to perform the design through manufacturing stages of the life cycle of composite and metallic structural parts, and specifies the ISO 10303 integrated resources necessary to satisfy these requirements.

This application supports the definition of the shape of the product and that of the constituents which make up the product. Three-dimensional shape representations are extended to include, not only the geometry representing nominal shape, but also the capability to define allowable variations by means of tolerances applied directly to the three-dimensional model. It is also extended to include the capability to define allowable variations in the surface texture.

The support for composite parts includes the ability to define the inner structure of these parts as defined by the lamination of plies or other constituent parts processed in its manufacture. The design support includes the capability to define the shape of these constituents in the context of a design surface such as outer mold line or tooling lay-up surface.

The design release of the product definition is supported by identification of a product and documentation of the formal change and release of designs for the product. The effectivity of the use of the product is supported. Also supported is the relationship of other documentation to that product.

The interface to manufacturing is supported by capability to define a top level manufacturing plan with identification of major manufacturing steps, tools, manufacturing comsumable materials, and manufacturing synthetic part identification. This plan also give capability to define manufacturing shapes which can be related to the design shape that is the requirement. A manufacturing as-planned bill-of-materials could then be developed from this definition. The development of a detail process plan and the change to a scheduled work plan for a manufacturing execution system are not a part of this capability.

Application protocols provide the basis for developing implementations of ISO 10303. Application

protocols provide the basis for developing abstract test suites for the conformance testing of AP implementations.

Clause 1 defines the scope of the application protocol and summarizes the functionality and data covered by the AP. An application activity model that is the basis for the definition of the scope is provided in annex F. The information requirements of the application are specified in clause 4 using terminology appropriate to the application. A graphical representation of the information requirements, referred to as the application reference model, is given in annex F.

Resource constructs are interpreted to meet the information requirements. This interpretation produces the application interpreted model (AIM). This interpretation, given in 5.1, shows the correspondence between the information requirements and the AIM. The short listing of the AIM specifies the references to the integrated resources and is given in 5.2. The annotated listing of the AIM provides the commented EXPRESS listing including all the referenced integrated resources and is given in annex A. A graphical representation of the AIM is given in annex G. Additional requirements for specific implementation methods are given in annex D.

Figure 1 contains a high level planning information model for this application protocol. At this level, the product can be conceptualized as a part that has both design and manufacuring product definitions. Each definition has shape representations whose context must have an understood relation to the design requirements. These shape representations may include modifcations, tolerance variations, and surface texture allowance. The manufacturing product definition includes an overall manufacturing approach and the major resources such as tooling required by this approach.

Industrial automation systems and integration - Product data representation and exchange - Part 222: Application protocol:

1 Scope

This part of ISO 10303 specifies the integrated resources necessary for the scope and information requirements for design through manufacturing of composite and metallic structural parts.

This part of ISO 10303 specifies an application protocol for the exchange of computer-interpretable composite and metallic structural product definition including their shape, allowed variations to that shape, and the manufacturing concept to be used to achieve this part.

NOTE - The application activity model (AAM) in annex F provides a graphical representation of the processes and information flows which are the basis for the definition of the scope of this part of ISO 10303.

The following are within the scope of this part of ISO 10303:

— the definition of composite structural parts;

— the definition of metallic structural parts;

— the product definition and configuration control information pertaining to the design through manufacturing engineering stages of a product's development;

— the specification of tolerance that the final manufacturing shape must adhere to;

— the information relating the part to the adjoining components in an assembly by either explicit or external reference;

— a high level definition of the manufacturing plan including the definition of major resources such as tooling;

— the 2D and 3D models depicting the product shape;

— the five types of geometric and topologic model representations which include:

a) wireframe and surface without topology;
b) wireframe geometry with topology;
c) manifold surfaces with topology;

d) facetted boundary representation; and
e) advanced boundary representation.

— the association of the constituents of composite and metallic parts with the constituent shape model;

— the depiction of composite laminate tables describing the material, stacking sequence, orientation, and constituents of the composite or a portion of the composite with a defined shape;

— the identification of material specifications from internal and external sources and any properties to be controlled through the manufacturing process.

— the administrative information necessary to track the approval and configuration control of the design of a product at a point in the life cycle when approval and configuration control are necessary;

— a change to a design, including information to identify the change, at a point in the life cycle when tracking a change is necessary;

— the identification, when required, of the contract under which a design is developed and an analyses is performed;

— the identification of the security classification of a part.

The following are outside the scope of this part of ISO 10303:

— the business information for the management of an engineering project;

— the product definition and configuration control information pertaining to any information other than that necessary for design and analysis;

— alternate representation of the information by disciplines outside of design and manufacturing such as analysis;

— the use of constructive solid geometry for the representation of the shape of the product;

— the explicit representation of a or as-built bill-of-material;

— the explicit graphical presentations derivable from design or analysis product representations;

— specification of filament wound structures;

— the complete shop floor instructions to build the part in a particular facility;

— the product definition of initial or in-process part shapes.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of the IEC and ISO maintain registers of currently valid International Standards.

— ISO 31, *Quantities and units*.

— ISO 1000, *SI units and recommendations for the use of their multiples and of certain other units.*

— ISO 10303-1:1994, *Industrial automation systems and integration - Product data representation and exchange - Part 1: Overview and fundamental principles.*

— ISO 10303-1:1994, *Industrial automation systems and integration - Product data representation and exchange - Part 11: Description methods: The EXPRESS language reference manual*.

— ISO 10303-21:1994, *Industrial automation systems and integration - Product data representation and exchange - Part 21: Clear text encoding of the exchange structure.*

— ISO 10303-31:1994, *Industrial automation systems and integration - Product data representation and exchange - Part 31: Conformance testing methodology and framework: General concepts*.

— ISO 10303-41:1994, *Industrial automation systems and integration - Product data representation and exchange - Part 41: Integrated generic resources: Fundamentals of product description and support*.

— ISO 10303-42:1994, *Industrial automation systems and integration - Product data representation and exchange - Part 42: Integrated generic resources: Geometric and topological representation*.

— ISO 10303-43:1994, *Industrial automation systems and integration - Product data representation and exchange - Part 43: Integrated generic resources: Representation structures.*

— ISO 10303-44:1994, *Industrial automation systems and integration - Product data representation and exchange - Part 44: Integrated generic resources: Product structure configuration*.

— ISO/CD 10303-45, *Industrial automation systems and integration - Product data representation*

and exchange - Part 45: Integrated generic resources: Materials.

— ISO/CD 10303-47, *Industrial automation systems and integration - Product data representation and exchange - Part 47: Integrated generic resources: Shape tolerance*.

— ISO/CD 10303-49, *Industrial automation systems and integration - Product data representation and exchange - Part 49: Integrated application resources: Process Structure and Properties*.

3 Definitions and abbreviations

For the purposes of this Part of ISO 10303, the following definitions and abbreviations apply.

3.1 Terms defined in ISO 10303-1

This part of ISO 10303 makes use of the following terms defined in ISO 10303-1.

— application;

— application activity model;

— application context;

— application interpreted model;

— application object;

— application protocol;

— application reference model;

— assembly;

— conformance testing;

— context;

— data;

— data exchange;

— implementation method;

— information;

— integrated resource;

— interpretation;

— model;

— product;

— product data;

— structure;

— unit of functionality.

3.2 Terms defined in ISO 10303-31

This part of ISO 10303 makes use of terms defined in Part 10303-31.

3.3 Terms defined in ISO 10303-41

This part of ISO 10303 makes use of terms defined in Part 10303-41.

3.4 Terms defined in ISO 10303-42

This part of ISO 10303 makes use of terms defined in Part 10303-42.

3.5 Terms defined in ISO 10303-43

This part of ISO 10303 makes use of terms defined in Part 10303-43.

3.6 Terms defined in ISO 10303-44

This part of ISO 10303 makes use of terms defined in Part 10303-44.

3.7 Terms defined in ISO 10303-45

This part of ISO 10303 makes use of terms defined in Part 10303-45.

3.8 Terms defined in ISO 10303-47

This part of ISO 10303 makes use of terms defined in Part 10303-47.

3.9 Terms defined in ISO 10303-49

This part of ISO 10303 makes use of terms defined in Part 10303-49.

3.10 Terms defined in ISO 10303-203

This part of ISO 10303 makes use of terms defined in Part 10303-203.

3.11 Other definitions

For the purpose of this part of ISO 10303, the following definitions apply.

3.11.1 constituent
: a component used to fabricate a product.

3.11.2 design discipline
: the organization or activity whose purpose is to create a engineering design and representation of a product. This design and its representation is used as the basis of other activities such as analysis or manufacturing.

3.11.3 radius filler
: a constituent of a composite part which is used to fill the gap between constituent part with rounded corners.

3.11.4 roving
: material with tows in one direction formed into various cross sections.

3.11.5 structural part
: a part that has as its principle design requirement the support of a load. The role of this part in a product is defining the shape and protecting the product.

3.11.6 tow
: a continuous group of fibers collected into a loose strand or assemblage without any substantial twist. It may be impregnated with a resin.

3.11.7 yarn
: a twisted group of fibers that may be woven into a fabric.

3.12 Abbreviations

For the purposes of this part of ISO 10303, the following abbreviations apply.

AAM	application activity model
AIC	application interpreted construct
AIM	application interpreted model
AP	application protocol
ARM	application reference model
B_REP	boundary representation
BOM	bill-of-material
CAD	computer aided design
CSP	composite structural part
ICAM	integrated computer-aided manufacturing
ID	identification
IDEF0	ICAM definition language 0
IDEF1X	ICAM definition language 1 - extended
PICS	protocol information and conformance statement
SP	structural part
UoF	Units of Functionality

4 Information requirements

This clause specifies the exchange of computer-interpretable composite and metallic structural product definition from design to the manufacturing.

The information requirements are specified as a set of units of functionality, application objects, and application assertions. These assertions pertain to individual application objects and to relationships between application objects. The information requirements are defined using the terminology of the subject area of this application protocol.

NOTES

1 - A graphical representation of the information requirements is given in annex F.

2 - The information requirements correspond to those of the activities identified as being in the scope of this application protocol in annex E.

3 - The mapping table is specified in 5.1 which shows how the information requirements are met using the integrated resources of this International Standard. The use of the integrated resources introduces additional requirements which are common to other application protocols.

4.1 Units of functionality

This subclause specifies the units of functionality for the design to manufacturing for composite and metallic parts application protocol.This part of ISO 10303 specifies the following units of functionality:

— advanced_boundary_representation;

— assembly;

— composite_assembly;

— composite_shape

— effectivity;

— faceted_boundary_representation;

— manifold_surface_with_topology;

— material_form

— manufacturing

— non_topological_surface_and_wireframe;

— part_description;

— part_identification;

— support;

— tolerance;

— tolerance_model;

— wireframe_with_topology;

4.1.1 advanced_boundary_representation

The advanced_boundary_representation UoF contains the representation of the part by shapes using advanced boundary representation solid models. This representation allows for the definition of curves and surfaces and the topology that bounds them. Boundaries are explicitly defined only by topology. All of the geometry that defines the part shapes shall be associated with topology.

The following application object is used by advanced_boundary_representation:

— Advanced_B_rep.

4.1.2 assembly

The assembly UoF represents either directly or by external reference, the components assembled into the part.

The following application objects are used by assembly:

— Assembly_located;

— Assembly_occurance_located;

— Assembly_occurance_quantified;

— Assembly_quantified;

— Stock_amount;

— Stock_material;

— Stock_material_metallic.

4.1.3 composite_assembly

The composite_assembly UoF describes the assembly of composite constituents into the final part. This includes the capability to define the order or layer these constituents are in the assembly process.

The following application objects are used by composite_assembly:

— Composite_layup_assembly;

— Composite_layup_assembly_table;

— Composite_layup_sequence_definition;

— Constituent_composite_part;

— Filament_laminate;

— Ply;

— Ply_laminate;

— Ply_laminate_sequence_definition;

— Ply_laminate_table;

— Ply_piece;

— Processed_core;

— Reinforcement_orientation_basis;

— Stock_material_composite;

— Zone_laminate_table;

— Zone_shape.

4.1.4 composite_shape_representation

The composite_shape_representation UoF contains the geometric constructs that compose the shape representation of composite parts including plies. The information consists of the mathematical definition of all two-dimensional and three-dimensional geometric elements that compose a ply shape representation. The elements may be points, curves, surfaces, vertices, edges, loops, faces, or shells.

The following application objects are used by composite_shape_representation:

— Beveled_sheet_representation;

— Composite_shape_representation;

— Composite_sheet_representation;

— Composite_sheet_representation_geometric;

— Composite_sheet_representation_topological;

— Geometry_3d_set;

— Ply_shape_type;

— Ply_shape_type_flat_pattern;

— Ply_shape_type_laid;

— Ply_shape_type_projected;

— Ply_shape_type_surface;

— Tape_strip_representation.

4.1.5 effectivity

The effectivity UoF represents the planned usage of components in a planned configuration and identification of the end product model.

The following application objects are used by effectivity:

— Date_effectivity;

— Effectivity;

— Lot_effectivity;

— Product_configuration;

— Product_model;

— Sequence_effectivity.

4.1.6 faceted_boundary_representation

The faceted_boundary_representation UoF contains the representation of the part using shapes that planar surfaces are the bounding surfaces for the solid model. Only points and planar polygons are used in this representation. Much of the topological information is implicit for this representation.

The following application object is used by faceted_boundary_representation:

— Faceted_boundary_representation.

4.1.7 material_form

The material_form UoF identifies the form or shape of the raw or stock material used to fabricate parts.

The following application objects are used by material_form UoF:

— Angle_material_form;

— Bar;

— Broadgoods;

— Channel_material_form;

— Film;

— Hexagonal_bar;

— Honeycomb_core;

— Rectangular_tube;

— Round_bar;

— Sheet;

— Stock_material_form;

— Tow;

— Unidirectional_tape.

4.1.8 manifold_surface_with_topology

The manifold_surface_with_topology UoF contains the representation of the shape of a part using manifold surfaces with topology. The outer boundary of the part is defined by 3D curves, surfaces, and topology.

The following application object is used by manifold_surface_with_topology:

— Manifold_surface_with_topology.

4.1.9 manufacturing

The manufacturing UoF describes the manufacturing plan and resources to support it.

The following application objects are used by manufacturing:

— Manufacturing_plan;

— Manufacturing_plan_activity;

— Manufacturing_resource;

— Tool.

4.1.10 non_topological_surface_and_wireframe

The non_topological_surface_and_wireframe UoF contains the representation of the shape of a part using surface or wireframe geometry without geometry. These representations are formed only by the use of points, curves, and surfaces. The boundaries of the curves are defined explicitly by points on the curves and by explicit associations between the points and the curves they bound. The boundaries of the surfaces are defined by curves on the surfaces and by explicit associations between the curves and the surfaces they bound. Surfaces and curves shall be explicitly trimmed unless they are closed.

The following application object is used by non_topological_surface_and_wireframe:

— Non_topological_surface_and_wireframe.

4.1.11 part_description

The part_description UoF contains the description of the processes, finishies and surface texture of a part.

The following application objects are used by part_description

— Cure_process;

— Heat_treat;

— Surface_coating_or_plating;

— Surface_texture.

4.1.12 part_identification

The part_identification UoF is the structure through which a part, unique versions of a part, and different discipline views of a part can be defined.

The following application objects are used by part_identification:

— Design_definition;

— Part;

— Part_definition

— Part_version.

4.1.13 support_resources

The support_resources UoF are the objects needed to support the definition and release of a part design.

The following application objects are used by support_resources:

— Approval;

— Change_notice;

— Company;

— Person_organization;

— Release_notice;

— Security_classification.

4.1.14 tolerance

The tolerance UoF contains the objects to define the allowable variations of size and form.

The following application objects are used by tolerance:

— Angular_tolerance;

— Angularity;

— Circularity;

— Concentricity;

— Conditioned_datum;

— Cylindricity;

— Datum;

— Flatness;

— Geometric_tolerance;

— Linear_profile;

— Material_condition_modifier;

— Parallelism;

— Perpendicularity;

— Position;

— Radial_tolerance;

— Runout;

— Shape_aspect;

— Straightness;

— Surface_profile;

— Symmetry.

4.1.15 tolerance_model

The tolerance_model UOF defines the objects necessary to define the allowable variation of size and form of the part from the geometric model size and form.

The following application objects are used by tolerance_model:

—Feature_location_tolerance;

— Model_least_material_condition;

— Model_location_tolerance;

— Model_maximum_material_condition;

— Model_shape_tolerance;

— Model_tolerance.

4.1.16 wireframe_with_topology

The wireframe_with_topology UoF contains the representation of the shape of a part by wireframes that are defined by edge topology. This included 3D curves and topology.

The following application object is used by wireframe_with_topology:

— Wireframe_with_topology.

4.2 Application objects

This subclause specifies the application objects for the design to manufacturing of composite and metallic structures application protocol. Each application object is an atomic element that embodies a unique application concept and contains attributes specifying the data elements of the object. The application objects and their definitions are given below.

4.2.1 Advanced_b_representation

An Advanced_b_representation is a Geometric_model_representation which is the topological definition of the surfaces which define the shape of a part.

4.2.2 Angle_extrusion

An Angle_extrusion is a type of Stock_material_form that has a crossectional area defined by two legs formed at right angles to each other. Each leg is the same thickness. The data associated with an Angle_extrusion are the following:

— leg1_height

— leg2_height

— thickness

4.2.2.1 leg1_height

The leg1_height specifies the dimension from the outside of the part crossection to the end of one of the two legs.

4.2.2.2 leg2_height

The leg2_height specifies the dimension from the outside of the part crossection to the end of other of the

two legs.

4.2.2.3 thickness

The thickness specifies the dimension between the inner and outer surface of each leg.

4.2.3 Angularity_tolerance

An Angularity_tolerance is type of Geometric_tolerance that specifies the allowable variation of an axis or ruled surface in it's angle orientation with respect to a reference datum. The allowable variation is defined by a linear dimension that is applied in either a derived plane or any plane perpendicular to a defined direction. An Angularity_tolerance is limited in application to ruled surfaces, hole center-lines, and straight edges. When it is applied to a hole center-line or a straight edge and the primary datum (first geometric_reference) is a also either a hole center-line or straight edge, they must both lie in a common plane.

NOTE

The plane that the allowed variation is defined is a replacement for the view plane that a drawing angularity tolerance would be specified .

The data associated with an Angularity_tolerance are the following:

— geometric_reference

— reference_direction

4.2.3.1 geometric_reference

The geometric_reference specifies the ordered set of Datums that are used to define the tolerance. The first Datum in the set is always the primary datum. The other datums are applied in their respective order.

4.2.3.2 reference_direction

The reference_direction specifies a direction which is used to define the allowable variation. The allowable variation is a linear dimension in the plane at right angle to this direction. The reference_direction does not always have to be specified since it can be understood from some instances.

EXAMPLE

The angularity of a hole is given a Angularity_tolerance with the primary data is an intersecting surface and a

secondary data of a surface perpendicular to this primary data. The Angularity_tolerance could be understood to apply in any plane parallel to the secondary datum.

4.2.4 Approval

An Approval is the indication within an organization of concurrence or nonconcurrence with a piece of product data. An Approval shall consist of a list of persons and organizations defined by each application

The data associated with an Approval are the following:

— effective_date;

— purpose;

— status.

4.2.4.1 effective_date

The date specifies when the approval became or will become effective.

4.2.4.2 purpose

The purpose specifies the reason for the approval.

4.2.4.3 status

The status specifies the state of consent applied to a piece of product data or a relationship between pieces of product data. Valid values for the status of an approval are: approved and not approved. Approved means the required concurrence has been established. Not approved means the required concurrence has not been established.

4.2.5 Assembly_located

An Assembly_located is a Design_definition of a Part consisting of other Parts fitted together. The location of each of these component Parts is in this definition.

4.2.6 Assembly_occurrence_located

An Assembly_occurrnce_located is the definition of a particular incident of a component Part located

relative to the assembly. The data associated with an Assembly_occurrence_located are the following:

— assembled_in

— component

— occurrence_place

4.2.6.1 assembled_in

The assembled_in identifies the Design_definition of the Part which is the assembly.

4.2.6.2 component

The component identifies the Design_definition of the Part which is fitted into the assembly.

4.2.6.3 occurrence_place

The occurrence_place specifies the location of the component Part in the assembly. A location is the definition of both a point and orientation defined relative to the overall assembly definition.

4.2.7 Assembly_occurrence_quantified

An Assembly_occurrence_quantified is the definition of a component Part being used in an assembly where the number of occurrences is specified. The data associated with an Assembly_occurrence is the following:

— quantity

4.2.7.1 quantity

The quantity specifies the count of the number of incidences of a component Part in this assembly Part.

4.2.8 Assembly_quantified

An Assembly_quantified is a Design_definition of a Part consisting of other Parts fitted together. The assembly is defined by the component parts and their respective number of occurrences.

4.2.9 Bar

A Bar is a type of Stock_material_form that has a rectangular cross-section. A Bar has a discrete width as

well as a thickness. The data associated with a Bar are the following:

— thickness

— width

4.2.9.1 thickness

The thickness specifies the dimension between the two surfaces which are closest together.

4.2.9.2 width

The width specifies the dimension between the two edge surfaces. The width is greater than or equal to the thickness.

4.2.10 Beveled_sheet_representation

A Beveled_sheet_representation is a composite_shape_representation which has a significant thickness and whose edge is beveled at a constant angle around its entire perimeter. It is an extension of the concept of a thin sheet to products such as honeycomb core which has significant thickness but can be formed to mate with a curved surface.

The data associated with a Beveled_sheet_representation are the following:

— bevel_angle;

— boundary_surface;

— vertical_profile_height.

4.2.10.1 bevel_angle

The bevel_angle specifies the angle from the plane normal to the defining surface of part's profile to the beveled surface.

4.2.10.2 boundary_surface

The boundary_surface specifies the base exterior boundary and defining surface of the part.

4.2.10.3 vertical_profile_height

The vertical_profile_height specifies the vertical height of the part's profile from the base boundary to where the bevel begins.

4.2.11 Boundary_representation

A Boundary_representation is the set of curves which define the sheet edge. These curves define a closed area but are not necessarily restrained topologically. The curves which encompass the other curves are the outer boundary, while curves which define a closed area within this outer boundary are cutouts.

Informal Proposition:

Rule — The curves are trimmed 3D curves defined on the basis surface of the Composite_sheet_representation.

The data associated with a Boundary_representation is the following:

— bounds

4.2.11.1 bounds

The bounds provides a set of curves which defines the boundary aspect.

4.2.12 Broadgood

A Broadgood is a type of Stock_material_form that is similar to cloth or fabric in form and handling . The data associated with a Broadgood are the following:

— thickness
— width

4.2.12.1 thickness

The thickness specifies the dimension between the two surfaces of the material.

4.2.12.2 width

The width specifies the dimension between the two edges when the material is held flat. The width need not be specified for a particular Broadgood.

4.2.13 Change_notice

A Change_notice documents the creation of a new Part_version or the change of the design definition of

an existing Part_version.

The data associated with a Change_notice are the following:

— change_date;

— class;

— creates;

— creator;

— deletes;

— modifies;

— releases;

— reason;

— type.

4.2.13.1 change_date

The change_date specifies the date when the Change_order became effective.

4.2.13.2 class

The class identifies classification type that this change belongs.

4.2.13.3 creates

The creates identifies the Part_version's which this change created.

4.2.13.4 creator

The creates identifies the person and organization that created this change.

4.2.13.5 deletes

The deletes identifies the Design_definition's, Toleranced_shape_model's, Effectivity's,

Assembly_occurence_located's, and Assembly_occurenence_quantified's that this change deleted.

4.2.13.6 modifies

The modifies identifies the Design_definition's, Toleranced_shape_model's, Effectivity's, Assembly_occurence_located's, and Assembly_occurenence_quantified's that this change modifies.

4.2.13.7 releases

The releases identifies the Design_definition's, Toleranced_shape_model's, Effectivity's, Assembly_occurence_located's, and Assembly_occurenence_quantified's that this change releases.

4.2.13.8 reason

The reason is textual description of why this change was made.

4.2.13.9 type

The type is the identification of classification of the impact that this change will have.

4.2.14 Channel

A Channel is a type of Stock_material_form that is 'U' shaped in it's cross-section. A channel has constant thickness in all three legs of its cross-section and both legs are of equal length and perpendicular to the bottom. The data associated with a Channel are the following:

— height

— thickness

— width

4.2.14.1 height

The height specifies the dimension form the outside face of the 'u' to end of either leg.

4.2.14.2 thickness

The thickness specifies the dimension between the two surfaces which are closest together. The thickness applies to both legs and the center web.

4.2.14.3 width

The width specifies the dimension from the outside of one leg to the outside of the other leg. A total width.

4.2.15 Composite_constituent_part

The Composite_constituent_part is a composite item which make up a composite part.
Composite_constituent_part may or need not be defined in a component assembly relationship.

The data associated with a Composite_constituent_part is the following:

— of_part

4.2.15.1 of_part

The of_part specifies the part of which the composite item is a constituent.

4.2.16 Composite_layup_assembly

The Composite_layup_assembly is a physical or conceived assembly which is made of multiple materials that are bonded together. A completed Composite_layup_assembly need not be a rigid shape. The Composite_layup_assembly may be made from any combination of material.
Composite_layup_assemblies may be used as a composite part but they need not be.

The data associated with a Composite_layup_assembly are the following:

— layup_part

— shape

Informal Proposition:

Rule 1 — Layup_parts must include constituent parts other than plies. A list of plies is a Ply_laminate.

Rule 2 — A Composite_layup_assembly can not point back to itself.

4.2.16.1 layup_part

The layup_part provides constituent parts which make up a Composite_layup_assembly.These constituents

may be any combination of the following: another composite assembly, filament laminate, ply, or a processed core.

4.2.16.2 shape

The shape of the Composite_layup_assembly. This is defined in terms of the part's final shape.

4.2.17 Composite_layup_assembly_table

A Composite_layup_assembly_table is an assembly table that provides an ordered list of constituent_part(s). This ordered list provides basic placement position within the laminate.

NOTES

1 — The valid components of this table are Ply(s), Ply_laminate(s), filament_laminate(s), processed_core(s), and composite_layup_assembly(s).

2 — This table is only valid to describe a composite_layup_assembly.

The data associated with a composite_layup_assembly_table is the following:

— sequence_groups

4.2.17.1 sequence_groups

The groups of components in sequence to be laid up.

4.2.18 Composite_layup_sequence_definition

An Composite_layup_sequence_definition is a single unique sequence or layer within a Composite_layup_assembly. This sequence or layer contains one or more constituent Parts. When more than one constituent Part resides in the same sequence or layer, the constituents must not overlap.

NOTE — If constituents do overlap they must be put on separate sequence or layers.

The data associated with a composite_layup_sequence_definition is the following:

— components_in_sequence

4.2.18.1 components_in_sequence

Components_in_sequence is the list of components of a single unique sequence or layer in a part.

4.2.19 Composite_shape_representation

Composite_shape_representation is the geometric model representation which composes the shape representation of composite part constituents.

4.2.20 Composite_sheet_representation

A Composite_sheet_representation is a Composite_shape_representation of a sheet product. A sheet product is a product whose thickness is constant and small in comparison to its length and width. Most sheet products will conform to the surface which they are placed. This product shape is represented as an actual shape on some surface or is projected to a surface which has a defined role for the part.

EXAMPLE 1 — Some typical composite sheet thickness are from 0.1 to 0.4 millimeters thick while the length and width are much greater than 25 millimeters.

Informal Proposition:

RULE — The thickness must be consistent with the thickness of the Constituent_composite_part that it represents.

The data associated with a Composite_sheet_representation is the following:

— thickness

4.2.20.1 thickness

The minimum length from the top face to the bottom face.

4.2.21 Composite_sheet_representation_geometric

A Geometric_sheet_representation_geometric is a Composite_sheet_representation which is defined by a surface and a set of curves. These curves are related in the application to that surface. The curves define a closed area but are not necessarily restrained topologically.

The data associated with a composite_sheet_representation_geometric are the following:

— basis_surface

— cutouts

— outer_edge

4.2.21.1 basis_surface

The surface used to define shape and having some known context to the part being represented. This surface may be the layup surface, inner-mold-line surface, outer-mold-line surface, or other.

4.2.21.2 cutouts

The definition of areas by sets of curves which are to be removed from the interior of the part.

4.2.21.3 outer_edge

The set of curves which define the outside edge (or boundary) of the part.

4.2.22 Composite_sheet_representation_topological

A Composite_sheet_representation_topological is a Composite_sheet_representation which is defined topologically.

The data associated with a Composite_sheet_representation_topological are the following;

— outer_bound

— inner_bounds

— face_surface

4.2.22.1 face_surface

The face_surface specifies the basis surface for the face

4.2.22.2 inner_bounds

The inner_bounds specifies a set of topologically defined loops which defines any cutouts in the sheet.

4.2.22.3 outer_bounds

The outer_bounds specifies the topologically defined loop which is the outer edge of the sheet.

4.2.23 Concentricity

(CONSIDER DROPPING THIS ENTITY- see position and circular_runout)

A concentricity is a type of Geometric_tolerance that specifies that the median points of all diametrically opposed elements of a shape that is a surface of revolution are congruent with the axis (or center point) of a datum. The definition of congruence is the specified tolerance. The data associated with a Concentricity_tolerance are the following:

— geometric_reference

4.2.23.1 geometric_reference

The geometric_reference specifies a Datum that defines the point of congruence for the median points.

4.2.24 Conditioned_datum

A Conditioned_datum is a type of Datum which is modified by a material condition modifier. The data associated with a Conditioned_datum is the following:

— conditioned_by

4.2.24.1 conditioned_by

The conditioned_by specifies a material condition modifier of “maximum material condition” (MMC), “least material condition” (LMC), or “Regardless of Feature Size” (RFS).

4.2.25 Cure_process

A Cure_process is the specification of the pressure, temperature, and cycle times to subject pre-preg composite material in order to achieve a finished product.

4.2.26 Cylindricity_tolerance

A Cylindricity_tolerance is a type of Geometric_Tolerance that specifies the allowable variation of a surface from the condition that all points are equidistant from a center line. The allowable variation is defined by two concentric cylinders whose spacing apart is equal to the tolerance amount.

4.2.27 Date_effectivity

A Date_effectivity is a type of effectivity. It is the specification by the design organization of the expected usage of a part in a product configuration. The usage of the part within the product configuration is determined by one or two associated dates. The data associated with Date_effectivity are the following:

— end_date

— start_date

4.2.27.1 end_date

The end_date specifies the last date on which the part is planned to be used or was used in the Product_Configuration.

4.2.27.2 start_date

The start_date specifies the first date on which the part is to be used or was used in the Product_configuration. No end_date at the time of exchange signifies that an end_date has not yet been identified.

4.2.28 Datum

A theoretically exact geometric reference that can be used by tolerances. A Datum is the origin from which the location or geometric characteristics of a Part are established.

4.2.29 Draped_orientation_angle

A draped_orientation_angle is an orientation_angle that exists at some point within the part.

NOTE - The draped_orientation_angle will change in the part if the surface of the part has complex curvature.

4.2.30 Design_definition

A Design_definition is one of the design organizational definitions or views of a Part_version. A Design_definition is controlled by the design organization.

NOTE — This entity may be used to capture the definition of a particular Part_version at any intermediate stage of its development where the definition is not formally released by an organization at the Part_version level. It may be used to capture the various stages in the definition cycle of a product. In the case of composite parts the

views to capture include a view of an item's shape, a view of the order constituents are assembled, and a view of the physical constituents that make up a particular feature of the part.

— approves

— CAD_filename

— creation_date

— descipline_identification

— description

— part_version

4.2.30.1 approves

The approves indicates within an organization of concurrence or nonconcurrence with this product data.

4.2.30.2 CAD_filename

The Computer_aided_design_filename (CAD_filename) specifies the name of the file that contains the geometric description in a computer aided design system. This reference is optional but, if it is provided, the reference is interpreted to be to an external definition of the shape of the part that is meaningful only within the organization that designed the part.

4.2.30.3 creation_date

The creation_date specifies the date that the Design_discipline_product_definition was first defined.

4.2.30.4 description

The description specifies the purpose for a particular definition of the product.

EXAMPLE 2 — A laminate_table is a type of Design_discipline_product_definition where the description might read, layup Ply table for Laminate providing sequence positioning for all plies in the laminate, or thickness laminate table providing the Ply stack at a particular area or point on the laminate.

4.2.30.5 discipline_identification

The discipline_identification specifies the identification of the functional unit or group within the

organization which the definition of the product pertains.

4.2.30.6 part_version

The part_version that this product data defines.

4.2.31 Design_model

A Design_model is the part shape as defined by the design discipline.

The data associated with a Design_model are the following:

— defining_shape

— design_view

4.2.31.1 design_view

The Design_discipline_product_definition that this model is a shape.

4.2.31.2 defining_shape

The geometric model defined.

4.2.32 Discontinuous_fiber_assembly

Discontinuous_fiber_assembly is a stock material which is a collection of short fibers suspended in a homogeneous material (matrix). Usually the length of the fibers are relatively the same within a detail. The orientation of the fibers is usually random.

NOTES

1 — When a Ply is made from a Discontinuous_fiber_assembly the Discontinuous_fiber_assembly is in the form of a sheet or is applied as a constant thickness coating to the area defined by the Ply.

2 — Some Resin Transfer Molded (RTM) parts can be viewed as Discontinuous_fiber_assembly. This is where the mixture of short fibers and matrix is injected into a mold.

EXAMPLE 3 — Fiberglass chop and mat are types of Discontinuous_fiber_assembly.

4.2.33 Draped_defined_orientation_angle

A draped_defined_orientation_angle is an orientation_angle that defines a position and direction within a part at which a point and warp direction of a fabric shall be placed prior to draping over the part.

Note - Once the fabric has been draped the orientation angle at any given point must be derived from the draped shape of the fabric.

4.2.34 Effectivity

Effectivity is the intended use of a part in a particular configuration of a product.

The data associated with an effectivity are the following:

— affected_assemblies

— configuration_item

4.2.34.1 affected_assemblies

The product which this effectivity applies.

4.2.34.2 configuration_item

The product_configuration which this effectivity applies.

4.2.35 Faceted_boundary_representation

A Faceted_boundary_representation is a Geometric_model_representation that represents the shape of a part or an aspect of the shape of a part by a faceted boundary representation solid model. This representation allows for the definition of shapes represented by planar surfaces as the bounding surfaces. Only points and planar polygons are used in this representation. Much of the topology information is implicit for this representation. Shells consist of faces bounded exclusively by planar polygons.

4.2.36 Filament_assembly

Filament_assembly is a stock material which is a collection of yarns or tows combined together in some manner and frequently embedded in a matrix of homogenous material. The Filament_assembly is usually measured by weight and sometimes length to describe the amount needed for a Filament_laminate.

NOTE

1 - When a ply is made from a Filament_assembly it is usually referred to as woven or non-woven fabric such as broadgoods and tape. A Ply can also be made from such things as a collection of tows or yarn provided the tow or yarn lay flat in the area described by the Ply and they are a single thickness that does not stack on top of one another or overlap.

2 - The thickness or cross-sectional area of a Filament_assembly is specified in the Ply or Filament_laminate which is made from this stock material. These are usually specified in cured thickness or cross-sectional area.

EXAMPLE 4 - Woven and non-woven fabric, individual tows, yarns, and roving are types of filament assemblies.

4.2.37 Filament_laminate

Filament_laminate is a bonded material of two or more bundles of filament construction. The Filament_laminate defines a volume to fill with filament assemblies.

NOTES

1 — The shape of a Filament_laminate may be defined by a cross section and a length.

2 — When a Filament_laminate is made from a Filament_assembly, it usually refers to individual tows, yarns, and rovings. These volumes can be as simple as the cross section and length of a radius filler to as complex as a filament wound vessel. Filament_laminates that are made by pulling and forming processes called pultrusions may use a tape form of Filament_assembly.

3 — The difference between a Ply and a Filament_laminate, when referencing a Filament_assembly, is that a Ply describes a constant thickness area to be filled by a Filament_assembly and a Filament_laminate describes a general volume to be filled by a Filament_assembly.

EXAMPLE 5 — Pultruded shapes, radius fillers, and filament wound structure.

The data associated with a Filament_assembly are the following:

— cross_section

— made_from

4.2.37.1 cross_section

The geometry which defines the cross-sectional area of a Filament_laminate.

4.2.37.2 made_from

A made_from specifies the stock Filament_assembly that the Filament_laminate is made from. The Filament_assembly is in the form of a tow, yarn or roving, and sometimes tape.

4.2.38 Film

A Film is a type of Stock_material_form that is a thin sheet or membrane of material. A Film is generally very flexible and may require a backing material or special handling. The data associated with a Film is the following:

— thickness

4.2.38.1 thickness

The thickness specifies the dimension between the two surfaces of the Film.

4.2.39 Flatness_tolerance

A Flatness_tolerance is a type of Geometric_tolerance that specifies the allowable variation of a surface from a plane. All points of the actual surface of the Part must lie between two parallel plates that are a spaced apart the distance of the tolerance amount.

4.2.40 Geometric_tolerance

A Geometric_tolerance is the allowed variation of shape on a Part instance that may be permitted in manufacture. The Geometric_tolerance is defined relative to the true geometric form or position defined by the Shape_model. The data associated with a Geometric_tolerance are the following:

— circular_zone

— magnitude

— modified_by

— tolerances

— unit_of_measure

4.2.40.1 circular_zone

The circular_zone is a yes or no specification of whether the tolerance amount defines a circular or cylindrical zone.

4.2.40.2 magnitude

The magnitude specifies the numerical value of the allowed variation. This value has units defined by unit_of_measure.

4.2.40.3 modified_by

The modified_by specifies a material condition modifier of “maximum material condition” (MMC), “least material condition” (LMC), or “Regardless of Feature Size” (RFS). The modified_by need not be specified for a particular Geometric_tolerance.

4.2.40.4 tolerances

The tolerances specifies the instances of Shape_aspect of the Part that is being toleranced by a Geometric_tolerance.

4.2.40.5 unit_of_measure

The unit_of_measure specifies the type of measure that defines the magnitude.

4.2.41 Geometry_3d_set

A geometry_3d_set is a 3D geometry model representation of composite part shape based on defining part boundaries on a surface. The geometry model consists of 3D boundary curves and surface geometry without topology. The surfaces used in the representation have a defined model surface context. The data associated with a 3D_geometry_set are the following:

- Basis_role;

- Basis_surface;

- Defining_boundary;

- Inner_mold_line_surface.

4.2.41.1 basis_role

The basis_role specifics the context of the basis surface for this part. 'Layup surface', 'Outer mold line'; and 'Inner mold line (IML)' are specific contexts.

4.2.41.2 basis_surface

The basis_surface is the surface used to define the part shape. The context of this surface is defined in the attribute basis_role.

4.2.41.3 defining_boundary

The defining_boundary specifics the curves which defines the edge aspect of a part.

4.2.41.4 inner_mold_line_surface

Inner_mold_line_surface is optional and if present specifies the inner mold line or the inner surface of the part away from the lay-up surface.

4.2.42 Geometric_model_representation

A Geometric_model_representation is the definition of the shape or a portion of the shape of a part.
The data associated with a Geometric_model_representation is the following:

— elements

4.2.42.1 elements

The geometry objects which make up this model.

4.2.43 Heat_treat

Heat_treat is the specification of a process to treat metallic material with a specific cycle of heating and cooling to produce specific material properties.

4.2.44 Hexagonal_bar

A Hexagonal_bar is a type of Stock_material_form that has a cross-section of six equal sides. The interior angle between any two adjacent sides is 120 degrees. The data associated with a Hexagonal_bar is the following:

— size

4.2.44.1 size

The size specifies the dimension across the flat of any two opposing faces of the hexagon.

4.2.45 Honeycomb_core

A Honeycomb_core is a type of Stock_material_form that the material is structured in open hexagonal, thin-walled cells. It has the same appearance as the wax hive where bees store their honey. The data associated with a Honeycomb_core is the following:

— thickness

4.2.45.1 thickness

The thickness specifies the dimension along the cells from one outside face to the other outside face.

4.2.46 Linear_profile_tolerance

A Linear_profile_tolerance is a type of Geometric_tolerance that specifies the variation of shape that occurs in a defined intersecting plane. The tolerance zone of allowed variation is defined as the two lines or curves offset opposite directions from the defined shape by one-half the magnitude. The Linear_profile_tolerance applies in any of the infinite planes which can be defined meeting the criteria. The criteria for the planes is defined by a specified directrix or perpendicular to both specified datums. The data associated with a Linear_profile_tolerance are the following:

— direction

— geometric_reference

4.2.46.1 direction

The direction specifies the intersecting planes in which the linear measure is to be made. The direction need not be specified when it can be derived from the geometric_reference.

4.2.46.2 geometric_reference

The geometric_reference specifes the datum or datums to be used as the basis for defining the allowable tolerance zone. The geometric_reference need not be specified.

4.2.47 Lot_effectivity

A Lot_effectivity is a type of Effectivity. It is the specification of the use of a part in a Product_configuration where the part is produced as one of a group. Lots are used when parts are produced in batches and/or when important characteristics might vary between production runs. The data associated with Lot_effectivity are the following:

— lot_number

— lot_size

— lot_size_unit_of_measure

4.2.47.1 lot_number

The lot_number specifies the identification of the group of parts that compose a lot.

4.2.47.2 lot_size

The lot_size specifies the quantity of parts within the lot.

4.2.47.3 lot_size_unit_of_measure

The lot_size_unit_of_measure specifies the fixed quantity amount, in terms of which the LOT_SIZE is expressed.

4.2.48 Manufacturing_plan

A Manufacturing_plan is a high-level description of the major steps necessary to manufacture a Part. The Manufacturing_plan is the first step in creating the manufacturing definition and includes identification of major tooling and resources by cell capability.

4.2.49 Manufacturing_plan_activity

A Manufacturing_plan_activity is a specific section of a Manufacturing_plan. This section is specific to a particular kind of production capability.

4.2.50 Manufacturing_resource

A Manufacturing_resource is the specification of the general manufacturing capability necessary to

produce a Part in a particular Manufacturing_plan_activity.

4.2.51 Material_condition_modifier

A Material_condition_modifier is the specification of Geometric_tolerance or Datum for a particular Geometric_tolerance is to be considered at one of the specified material conditons of Maximum_material_condition, Least_material_condition, or Regardless_of_material_condition.

4.2.52 Model_default_tolerance

REVISE)
A Model_default_tolerance is the specification of a size and position tolerance that applies to elements of the shape of a Part unless given a specific Geometric_tolerance. The data associated with a Model_default_tolerance is the following:

— geometric_reference

4.2.52.1 geometric_reference

The geometric_reference specifies the Datums that are the basis for the size and position variations.

4.2.53 Model_least_material_condition

Model_least_material_condition is the identification of Shape_aspects or Geometric_models that are defined at a least material condition. The data associated with a Model_least_material_condition is the following:

— applies

4.2.53.1 applies

The applies specifies the Shape_aspects or Geometric_models that are defined at least material condition.

4.2.54 Model_maximum_material_condition

A Model_mazimum_material_condition is the identification of the Shape_aspects or Geometric_models that are defined at a maximum material condition. The data associated with a Model_maximum_material_condition is the following:

— applies

4.2.54.1 applies

The applies specifies the Shape_aspects or Geometric_models that are defined at maximum material condition.

4.2.55 Model_tolerance

A Model_tolerance is a specification of the allowable variation of shape that applies to all elements of the shape unless a specific Geometric_tolerance provides other criteria. The data associated with a Model_tolerance are the following:

— magnitude

— unit_of_measure

4.2.55.1 magnitude

The magnitude specifies the numerical value of the allowed variation. This value has units defined by unit_of_measure.

4.2.55.2 unit_of_measure

The unit_of_measure specifies the type of measure that defines the magnitude.

4.2.56 Parallelism_tolerance

Parallelism_tolerance is a type of Angularity_tolerance that applies when the angle between the toleranced shape_aspect and the geometric_reference is zero or 180 degrees.

4.2.57 Laid_defined_orientation_angle

A Laid_defined_orientation_angle is an orientation_angle that explicitly defines a direction within a part.

4.2.58 Make_from

A Make_from is a type of Assembly. It is a relationship between two parts in which one part is used as the basis for the design of the other part.

EXAMPLE 6 — Company A buys a cup holder from company B and adds mounting holes to fasten the cup holder rather than using the gluing designed by company B. In this case, company A identifies the cup holder designed by company B as an Make-From.

.

4.2.59 Material_direction

A Material_direction is the identification of the principal direction of a material.

NOTE — A woven fabric will have both a warp and fill directions. This Material_direction will identify the warp direction for orientation in the laminate. The material direction of honeycomb core will be that of the cell direction.

The data associated with a Material_direction is the following:

— material_orientation

4.2.59.1 material_orientation

The direction which is the principal direction within the material.

4.2.60 Material_property

A Material_property is a quality of a material that is as measured by specific procedure and obtained by an accepted analysis. The data associated with Material_property are the following:

— property_name

— property_value

4.2.60.1 property_name

A label given to the property to describe what quality it represents.

4.2.60.2 property_value

The actual value that represents this quality of the material.

4.2.61 Material_specification

A material_specification is the informal or formal contractual, internal, or institutional document that details the production of qualities of a material. For composite materials, this specification shall include the following information:

— the percentages of fiber in the warp and fill directions;

— the text description of the weave of the fiber;

— the fiber volume content of the material;

— the resin content of the material; and

— the text description of sizing on tows prior to weaving and resin impregnation.

4.2.61.1 document

The specification which defines the material.

4.2.61.2 material_designation

The number or code that identifies the material.

4.2.62 Non_topological_surface_and_wireframe

A Non_topological_surface_and_wireframe is a Geometric_model_representation that represents the shape or portions of the shape of a part using surface or wireframe geometry without topology. These representations are formed by the use of points, curves, and surfaces only. The boundaries of the curves are defined explicitly by points on the curves and explicit associations between the points and the curves that they bound. The boundaries of the surfaces are defined by curves on the surfaces and explicit associations between the curves and the surfaces that they bound. Surfaces and curves must be explicitly trimmed unless they are closed.

4.2.63 Orientation_angle

An Orientation_angle defines a particular direction within a part. This direction is defined in the coordinate axis of a reinforcement_orientation_basis. The measurement is in degrees between -90 and +90. Each Orientation_angle orients a defined aspect of the part.

NOTES

1 — For materials with multiple fiber orientations, this direction shall correspond to the warp direction of the material. Warp fibers are the primary load carrying fibers within a material.

2 — Within the design of a particular composite part a finite number of Orientation_angles are established that will be valid for use. An example of a finite number of commonly used Orientation_angles is (0, 90, +45, -45)

The data associated with Orientation angle is the following:

— defined_angle

4.2.63.1 defined_angle

The defined_angle is the directional value within a part.

4.2.64 Part

A Part is an item that is intended to be produced or employed in a production process. The data associated with Part are the following:

— part_number

— part_nomenclature

— part_type

— standard_part

— weight

4.2.64.1 part_number

A part_number specifies the unique identification of a part for a particular organization.

EXAMPLE 7 — A drawing number with a dash number "BTES930032-001". A Ply might have an identification of "P02".

4.2.64.2 part_nomenclature

A part_nomenclature specifies a name by which the part is commonly known within an organization. Usually the name reflects the form and/or function of the part.

NOTE — The name can also have meaning outside of any single organization. For example, a single nation or industry can have naming conventions for different kinds of common parts.

EXAMPLE 8 — Skin Panel, "T" Stiffener, Access Door, Core Stiffened Panel, Leading Edge Fairing

4.2.64.3 part_type

The part_type is a Subtype of part_classification.

EXAMPLE 9 — Subtypes for a Filament_assembly would be tape, broadgoods, tow, yarn. Subtypes for a Homogeneous_material would be resin, potting compound, and parts such as machined punched or turned. Subtypes for a Composite_Layup_Assembly would be machined core panel, cured core panel, in-process core panel layup, two angle laminate assembly, etc. Subtypes for a Processed_core would be assembled core, machined core, stabilized core, formed core, etc. Subtypes for Ply_laminates would be flat, angle, channel, simple curvature, complex curvature, etc. Subtypes for Plies would be full, window frame, parcel, interior, spliced Ply etc. Subtypes for Ply_piece would be tape strip, gusset, filler, splice piece, etc. Subtypes for a Stock_core would be honeycomb, block, sheet, etc. Subtypes for Discontinuous_fiber_assembly would be mat, chop fiber, etc.

4.2.64.4 standard_part

The standard_part is an indicator which specifies whether or not a part has a design specified externally to the bill of material in which an assembly is being defined.

NOTE — A part may be a standard part for a company, industry or other organization.

4.2.64.5 weight

The weight of the part.

4.2.65 Part_laminate_table

The Part_laminate_table applies to the overall laminate and is used to provide allocation of each physical constituent through the use of an ordered placement list.

NOTES

1 — The existence of a Part_laminate_table for every laminate is not appropriate. For example a composite "T" that is made up of two angles and a cap might not find a Part_laminate_table very useful for the overall "T", but could use the Part_laminate_table for the individual angles and cap. A typical core panel would utilize a Part_laminate_table. The information a Part_laminate_table associates together will not necessarily satisfy all the assembly information needs. For a laminate using a Part_laminate_table each constituent of the laminate will need its own shape description and possibly location information. For a laminate that does not use a Part_laminate_table it's constituent placement or assembly can be handled through a basic placement transformation of each of it constituents shape into its assembled position, just like a mechanical fastened assembly.

2 — A Composite_layup_assembly_table will allow for the placement of two or more instances of the same Constituent_part on the same sequence or layer. A Ply_laminate_table will allow for the placement of only one instance of the same Constituent_part (only plies) on the same sequence or layer.

4.2.66 Part_version

A Part_version is the identification of the representation for a part before, during, or after its design has undergone a formal release or change. Only changes that are formally tracked by the organization that is responsible for the definition of the part shall be identified by this application object. Iterations on designs that are not formally tracked by the organization responsible for the definition of the part shall not be identified by this but should be tracked by Design_discipline_product_definition application object. The data associated with Part_version are the following:

— approvals

— contract_number

— make_or_buy_code

— part_number

— release_status

— revision_letter

— security_code

4.2.66.1 approvals

The indication within an organization of concurrence or nonconcurrence with this Part_version.

4.2.66.2 contract_number

The contract_number specifies the business contract under which the part is designed. A design may or may not have been developed under a contract, however, if the design was developed under a contract, this attribute shall specify the unique identification of that contract.

4.2.66.3 make_or_buy_code

The make_or_buy_code specifies the design organization's plan for obtaining the part. It will always be one to the two values make or buy. If the value of this attribute is make, the design organization has planned to make the part internally. If the value of the attribute is buy, the design organization plans for the part to be purchased from a vendor.

4.2.66.4 part_number

The part which this version represents.

4.2.66.5 release_status

The release_status specifies the status of the version of a part with respect to the dissemination of design information, It will always be one of two values: released or unreleased. Released are those versions that have been reviewed and approved for further use. Unreleased are those versions that have not been reviewed and subsequently approved for further use.

4.2.66.6 revision_letter

The revision_letter specifies the unique identification of a particular version of a part. Since the Part_version application object is also being used to manage pre-release engineering changes, the application object release_status should always have the value of "Unreleased" during the initial design or analysis phase until engineering officially releases the product information.

4.2.66.7 security_code

The security_code specifies the security classification of a particular version of a part.

4.2.67 Ply

A Ply is one of the layers of constant thickness material that makes up a composite part. A Ply is a contiguous structure with a defined boundary that is made of one or more Ply_pieces.

NOTES

1 — A Ply may be a sheet of preimpregnated with resin material or a single-pass in a filament. Ply pieces which comprise a Ply must be of the same constant thickness material and fiber orientation (if fiber orientation is required). A Ply can also be the application of a homogeneous material of constant thickness to an area. A Ply can also be not a physical piece of material but an idealization of material in a zone which shares common fiber orientation and boundary.

2 — The boundary of a Ply defines the edge of the material used to make the Ply which includes and outer boundary and, if required, inner boundaries.

4.2.67.1 constituents

The optional list of Ply_piece which make up this ply.

4.2.67.2 material_orientation

The orientation specifies the direction of the reinforcement fibers within a Ply. For materials with multiple orientations of fibers, orientation shall correspond to the warp direction of the material. Warp identifies the highest load carrying direction of the material.

4.2.67.3 material_type

The material_type is the stock_material which a Ply is made of. Only stock material that is a constant thickness or is applied as a constant thickness are valid.

4.2.67.4 ply_thickness

The ply_thickness specifies the thickness that this ply will contribute to part thickness after curing. This ply_thickness is constant over the whole area of the ply. This value is optional if the thickness is the same as stock_material.

4.2.67.5 shape_definition

The definition of the shape of this Ply.

NOTE — This value can not always be derived by the Stock_material that makes up the Ply. Applying formable material like potting compound over an area is an example where a thickness is required.

4.2.68 Ply_laminate

A Ply_laminate is two or more plies that mate with one another. The plies have unique orientation and shape within the Ply laminate.

NOTE — Within the Part application object which a Ply_laminate references through Constituent_part, the part type sub-application object should reflect the shape of the Ply_laminate. Examples include angle, cap, flat, general contour, simple contour, complex contour, channel, etc.

4.2.68.1 boundary

The boundary specifies the overall shape of Ply_laminate and/or Shape_aspects of the Ply_laminate such as the edge of the Ply_laminate and any internal cutouts.

4.2.69 Ply_table

The ply_table specifies an ordered list of the plies which make up this Ply_laminate.

4.2.70 Ply_laminate_sequence_definition

A Ply_laminate_sequence_definition depicts a single unique sequence or layer within a part (Ply_laminate). This sequence or layer does contain one or more Ply(s).

NOTE — When more than one Ply resides in the same sequence or layer, the plies must not overlap. If plies do overlap they must be put on separate sequence or layers.

The data associated with a Ply_laminate_sequence_definition is the following:

— plies_in_sequence

4.2.70.1 plies_in_sequence

The set of ply which are laminated at this sequence.

4.2.71 Ply_laminate_table

A Ply_laminate_table is an assembly table that provides an ordered list of Ply(s). This ordered list provides basic placement position within the laminate.

NOTES

1 — The valid components of this table are only Ply(s).

2 — This table is only valid to describe a Ply_laminate.

The data associated with a Play_laminate_table are the following:

— sequence

4.2.71.1 sequence

An ordered list of sets of ply(s) which make up this Ply_laminate.

NOTE — A particular sequence can be for one or several ply(s) that make up the set.

4.2.72 Ply_piece

A Ply_piece is a single portion of a Ply which may be combined with other Ply pieces on the same layer to make up a Ply. A Ply_piece has the same material and orientation direction as defined for the Ply of which

it is a portion.

NOTE — Stock_material may be too small to fully cover the area of a Ply. In this case, the application may allow two or more pieces to be used.

EXAMPLE 10 — Tape strips are a typical example of Ply_pieces that are grouped together to fill a Ply_shape.

The data associated with a Ply_piece are the following:

— shape

— warp_surface

4.2.72.1 shape

The definition of the shape of this Ply_piece.

4.2.72.2 warp_surface

A logical warp_surface which is true if the material warp surface is away from the basis surface. Material warp surface is the side of the material where the majority of the fibers are located.

4.2.73 Ply_shape

Ply_shape establishes the relationship between a geometric representation and the Ply that it defines the shape for. The data associated with a Ply_shape is the following:

— definining_model

— basis

4.2.73.1 basis

The basis identifies a ply_shape that this Ply_shape is defined from.

4.2.73.2 defining_model

The geometric representation that defines this shape.

4.2.74 Ply_shape_type_flat_pattern_

A Ply_shape_type_flat_pattern provides needed information to define a edge boundary in a flat pattern 2D perspective that is related to 3D. The data associated with a Ply_shape_type_flat_pattern are the following:

— origin_on_flat_pattern

— origin_on_surface

4.2.74.1 origin_on_flat_pattern

The origin_on_flat_pattern specifies the point of the flat pattern plane that corresponds directly to the origin_on_surface.

4.2.74.2 origin_on_surface

The origin_on_surface specifies the point on the surface_basis that corresponds directly to the origin_on_flat_pattern.

4.2.75 Ply_shape_type_laid

A Ply_shape_type_laid is a shape of the Ply in the actual Ply_laminate. This is the shape that will actually step up and down over the buildup of previous laid plies, composite_layup_assemblies, or other constituents.

4.2.76 Ply_shape_type_projected

A Ply_shape_type_projected is a Ply_shape which has its shape modeled by a projection on a surface. This surface has some defined context for the Ply. The data associated with a Ply_shape_type_projected is the following:

— projection_direction

4.2.76.1 projection_direction

The projection_direction optionally defines the direction from the given representation to the actual layed-up ply shape.

4.2.77 Ply_shape_type_surface

An Ply_shape_type_surface is a Ply_shape_type which is defined in surface defining some part of the composite part. This surface may be the layup surface, the OML, or the IML. The data associated with Ply_shape_type surface are the following:

— offset

— surface_role

4.2.77.1 offset

The offset specifies the distance from the modeled surface to the layup surface of the part.

4.2.77.2 surface_role

The surface_role defines the context of the surface defined to the actual part. Should be limited to text defining contexts such as 'layup surface', 'Outer mold line (OML)', and 'Inner mold line (IML)'. For layup surface offset distance would be zero.

4.2.78 Position_tolerance

A Position_tolerance is a type of Geometric_tolerance that specifies the allowable variation of the location of a Shape_aspect in a plane. The Shape_aspect must be either a cylindrical surface or two plane surfaces that are parallel. A Position_tolerance does not specify size of the Shape_aspect thus controls it’s location regardless of it’s size unless it is modified by a material condition modifier..

4.2.79 Processed_core

Processed_core is the central component of a sandwich construction to which the faces or skins are attached. The primary structural surfaces of Processed_core is the transfer of shear loads between the faces or skins. Processed_core is Stock_core that has been machined, formed, stabilized and/or bonded together. A core may have a potting compound or adhesive applied to it to make it more rigid and/or provide solid attachment points.

Informal Propositions:

RULE 1 — Must be at least one of the following attributes present: made_from stock or made_from_processed_core.

RULE 2 — Processed_core can not point back to itself.

The data associated with a Processed_core are the following:

— added_material

— cell_direction

4.2.79.1 added_material

The added_material, such as, stabilizer, potting compound, and adhesive identifies the added_material applied to a stock_core or processed_core. The Ply identifies the area where this added_material is applied.

4.2.79.2 cell_direction

The cell_direction identifies the cell orientation of core made out of honeycomb.

4.2.80 Product_configuration

A Product_configuration is a variation of a Product_model. All configuration management is based on this application object.

EXAMPLES

11 — A Product_configuration for the F-14 military aircraft is the D configuration of the F-14. The organization has defined four configurations of the F-14 A, B, C and D. D in this instance is the configuration. A single product model might have many different configurations in order for the organization to identify different variations of it.

12 — Product_configurations for the Camry automobile may be DS and LE, each defining different variations of the Camry Product_model.

— item_identification

— model_name

— part_configured

— phase_of_product

4.2.80.1 item_identification

The item_identification specifies the unique identification of a variation of the Product_model.

4.2.80.2 model_name

The Product_model which this configuration is a part of.

4.2.80.3 part_configured

The set of part_configured.

4.2.80.4 phase_of_product

The phase_of_product specifies the stage in the life cycle of the product in which a particular version of this design is planned to be produced.

EXAMPLE 13 — For example within an organization, four phases of a product may be Technology and Concept Development, Development and Refinement, Manufacturing and Assembly Validation, and Production.

4.2.81 Product_model

A Product_model is the product the organization provides to its customers. The product model is identified for planning purposes in the design stage of a product.

EXAMPLES

14 — F-22 is the identification of a Product_model that is a military aircraft. The company that produces this aircraft uses F-22 to identify the actual deliverable product that it delivers to its customers.

15 — Another example of a Product_model is the Camry. The name Camry is used to identify an automobile that is delivered to customers.

4.2.81.1 model_name

The model_name specifies the unique identification assigned by an organization to a product that the organization provides to its customers.

4.2.82 Radial_tolerance

A Radial_tolerance is a type of Model_tolerance which specifies the allowable variation of position of a surface can vay in a radial direction.

4.2.83 Rectangular_tube

A Rectangular_tube is a type of Stock_material_form that has a cross-section shape of a rectangle with a constant wall thickness. The data associated with a Rectangular_tube are the following:

— height

— wall_thickness

— width

4.2.83.1 height

The height specifies the outside dimension of size that is the larger.

4.2.83.2 wall_thickness

The wall-thickness specifies the dimension from the inside surface through material to the outside surface.

4.2.83.3 width

The width specifies the outside dimension of size that is the smaller.

4.2.84 Reinforcement_orientation_basis

A Reinforcement_orientation_basis is the definition of direction defined in terms of a Ply_laminate or composite layup assembly. It is the basis for interpretation of the fiber orientation within a Ply. The data associated with a Reinforcement_orientation_basis are the following:

— basis_location

— orientation

4.2.84.1 basis_location

The location of this orientation axis within the Ply_laminate. This location will be on the basis surface of the Laminate_table.

4.2.84.2 orientation

Positive placement x_axis is the fiber 0 degree direction, and the positive y-axis to the 90 degree direction. Angles are positive, counter-clockwise, in the XY plane (in accordance to the Right-Hand-Rule).

4.2.85 Release_notice

A Work_order is a document that authorizes work in the development of an initial or modified design or analysis of a part. It is the result of the processing of one or more work requests.

4.2.85.1 additional_data

The additional_data specifies additional pertinent information that was compiled during the development of the related set of proposed work requests.

4.2.85.2 authorized_by

The set of Work_request(s) which is authorized.

4.2.85.3 incorporated by

The Work_request which this Work_order incorporates.

4.2.85.4 work_order_identification

The work_order_identification specifies a unique identifier for the work authorized by the Work_order.

4.2.85.5 versions

The set of Part_version or Analysis version to which this order applies.

4.2.86 Round_bar

A Round_bar is a type of Stock-material that has a shape of a cylinder of unspecified length. The data associated with a Round_bar are the following:

— diameter

— gauge

4.2.86.1 diameter

The diameter specifies the dimension of a straight line segment through the center and terminating at the outside surface.

4.2.86.2 gauge

The gauge specifies a designation that is a standard size that the Round_bar conforms. The gauge need not be specified.

4.2.87 Sequence_effectivity

A Sequence_effectivity is a type of Effectivity. It is the specification of the intended use by a design organization of a part within a range of Product_configurations identified by planned serial numbers. The data associated with Sequence_effectivity are the following:

— from_effectivity_identification

— thru_effectivity_identification

4.2.87.1 from_effectivity_identification

The from_effectivity_identification specifies the beginning serial number of the range for the Sequence_effectivity.

4.2.87.2 thru_effectivity_identification

The thru_effectivity_identification specifies the ending planned serial number of the range for the sequence effectivity.

4.2.88 Shape

The Shape is the form of the part object.

4.2.89 Shape_aspect

A Shape_aspect is a distinct portion of a part. The shape of a part consist of one or more shape aspects.

NOTE — Often different types of geometric models will define the same shape or shape aspect of a part. This is usually caused by the diverse set of applications that sometimes have to be utilized in the design, analysis, and manufacturing of the part.

The data associated with a Shape_aspect are the following:

— geometry

— parent_shape

4.2.89.1 geometry

The geometry which represents this aspect of the shape.

4.2.89.2 parent_shape

The shape which this is a part of.

4.2.90 Sheet_material_form

A Sheet_material_form is a type of Stock_material_form that is a broad, thin, usually rectangular piece of continuous material. The size of the edges are normally much larger than an individual part and do not affect design definition. A Sheet_material_form is inclusive of thicker sheets commonly called plate stock.

NOTE:
A Sheet_material_form is not related to the concept of Composite_sheet_representation. A Composite_sheet_representation is a flexible sheet concept for defining shape of composite parts while most Sheet_material_form have significant rigidity.

The data associated with a Sheet_material_form are the following;

— gauge

— thickness

4.2.90.1 gauge

The gauge specifies a designation that is a standard size that the Sheet_material_form conforms. The gauge need not be specified.

4.2.90.2 thickness

The thickness specifies the dimension between the two major faces of a Sheet_material_form.

4.2.91 Stock_amount

Stock_amount is the relationship between the Part and the Stock_material used to fabricate the Part. This relationship represents the amount of Stock_material that is needed to fabricate the Part. The Stock_amount may be defined by the design engineering function as a predicted quantity. The Stock_amount may also be defined by the manufacturing engineering function as the amount to purchase and furnish to the shop floor. The quantity specified depends on the Stock_material_form.

EXAMPLE:
The size of a Sheet_material_form requires both a length and width while a Round_bar quantity is specified with a length.

The data associated with stock_amount are the following:

— net_area

— net_length

— net_outer_diameter

— as_required

— as_required_optional

— net_thickness

— net_volume

— net_width

— net_weight

4.2.91.1 net_area

The net_area is an optional specification of the area of Stock_material required to fabricate the part.

4.2.91.2 as_required

The as-required is an optional specification that some Stock_material is required to fabricate the part. The use of this Stock_material is required and it is not practical to predict how much will be required. This specification of amount would not be used with any other.

4.2.91.3 as_required_optional

The as-required_optional is an optional specification that some Stock_material may be reuired to fabricate the part. The use of this Stock_material is optional and it is not practical to predict how much will be required. This specification of amount would not be used with any other.

4.2.91.4 net_length

The net_length is an optional specification of the length of Stock_material that is needed to build the Part. Net_length is expressed as a dimension of length.

4.2.91.5 net_outer_diameter

The net_outer_diameter is an optional specification of the outside diameter of a cylinder of Stock_material needed to fabricate the Part. Net_out_diameter is expressed as a dimension of length and is normally also defined with a net-length.

4.2.91.6 net_thickness

The net_thickness is an optional specification of the thickness of Stock_material needed to fabricate the part. Net_thickness is express as a dimension of length.

4.2.91.7 net_volume

The net_volume is an optional specification of the volume of Stock_material neeeded to fabricate the part. Net_volume would not be used with any other specification of amount.

4.2.91.8 net_width

The net_width is an optional specification of the width of Stock_material needed to fabricate the Part. Net_width is expressed as a dimension of length and is normally given with a net_length.

4.2.91.9 net_weight

The net_weight is an optional specification of the mass of Stock_material needed to favricate the Part. Net_weight would not be used with any other specification of amount.

4.2.92 Stock_material

A Stock_material is the identification of the material used to fabricate a Part. Purchased material is normally defined by specifying the type of material and the form of the material. A Stock_material has the concept that it is some standard substance that may be used by many industry fabricators and often manufactured by several companies. It is a raw material to the fabrication process although it may be a finished material to the material supplier. The type of Stock_material is further subtyped into Stock_material_metallic, Stock_material_non_metallic, and Stock_material_composite. The data associated with Stock_material is the following:

— material_form

4.2.92.1 material_form

The material_form is the specification of the shape of the Stock_material as it is furnished from the material supplier.

4.2.93 Stock_material_composite

A Stock_material_composite is a type of Stock_material that has reinforcement material embedded in a matrix of binding material.

4.2.94 Stock_material_form

A Stock_material_form is the definition of the shape of the material used for fabrication in terms of regular stock forms.

NOTE:
A Stock_material_form is not a parameterized shape definition but is rather the identification of the size of a particular shaped regular “mill” product.

EXAMPLE:
A raw material supplier manufactures sheets of materials with thickness from one-thirty-seconds of an inch through one-half inch.

4.2.95 Stock_material_metallic

A Stock_material_metallic is a type of Stock_material that is an alloy of two or more metallic elements.

4.2.96 Straightness_tolerance

A Straightness_tolerance is a type of Geometric_tolerance that defines the allowable variation of shape in a plane from a straight line. For a cylindrical shape, the plane is any plane passing through the center. The data associated with a Strightness_tolerance is the following:

— direction

4.2.96.1 direction

A direction specifies the direction on a flat surface that the Straightness_tolerance applies. A direction need not be specified on a cylindrical shape.

4.2.97 Surface_coating_or_plating

A Surface_coating_or_plating is addition of a thin coating of a particular material to a particular surface of a part.

4.2.98 Surface_profile

A Surface_profile is a type of Geometric_tolerance that defines the allowable variation of shape of a surface from the defined shape. The allowable variation is defined by two surfaces a distance apart defined by a sphere whose diameter is the magnitude of the tolerance and whose center is the surface definition. The location of these surfaces is located in three dimensional space when the tolerance has appropriate geometric_references. The data associated with a Surface_profile_tolerance is the following:

— geometric_reference

4.2.98.1 geometric_reference

A geometric_reference specifies the Datums which locate the profile. A geometric_reference need not be specified.

4.2.99 Symmetry_tolerance

A Symmetry_tolerance is a type of Geometric_tolerance that defines the allowable variation the center point of opposing surfaces from the defined surface of symmetry. The data associated with a Symmetry_tolerance is the following:

— geometric_reference

4.2.99.1 geometric_reference

The geometric_reference specifies the Datums which define the tolerance variation. The first Datum specified is the datum about which symmetry is defined.

4.2.100 Tape_strip_representation

A Tape_strip_representation is the definition of the shape of a Ply_piece in terms of laying a piece of Unidirectional_tape. The definition consists of the definition of the tape center-line and the start and end cuts. The data associated with a Tape_strip_definition is the following:

— center_line

— start_end_cut

— stop_end_cut

4.2.100.1 center_line

The center_line is an ordered list of locations including a surface normal and a normal to the tape path that define the path of the tape center-line.

4.2.100.2 start_end_cut

The start_end_cut is an ordered list of points that define start edge of the tape by a series of line segments. At least one point of the list must lie on the line defined by the first location of the center-line. This line is defined by the location and the normal to the tape path.

4.2.100.3 stop_end_cut

The stop_end_cur is an ordered list of points that define the stop edge of the tape. The stop edge is defined by a series of line segments through the points. At least one point of the list must lie on the line defined by the last location of the center-line. This line is defined by this location and the normal to the tape path.

4.2.101 Tool

A Tool is a Part which is defined to enable the manufacture of a production Part.

4.2.102 Tow

A Tow is a type of Stock_material_form which is a continous group of fibers collected into a losse strand or assemblage without any substantial twist. The data associated with a Tow is the following:

— cross_sectional_area

4.2.102.1 cross_sectional_area

The cross_sectional_area is a measurement of the size of the void that any one cross sectional of the Tow will fill.

4.2.103 Total_runout_tolerance

A Total_runout_tolerance is a Geometric_tolerance that specifies the maximum allowable axial displacement at any position along it’s length on the toleranced feature during one complete revolution of

the feature about the datum axis . The data associated with Total_runout_tolerance is the following:

— geometric_reference

4.2.103.1 geometric_reference

The geometric_reference specifies the Datum that is used to define the axis of rotation.

4.2.104 Tube

A Tube is a type of Stock_material_form that is a hollow cylinder. The wall thickness of this hollow cylinder is constant. The data associated with Tube are the following:

— inner_diameter

— outer_diameter

— wall_thickness

— schedule

4.2.104.1 inner_diameter

The inner_diameter is the dimensional size of the inside cylinder.

4.2.104.2 outer_diameter

The outer_diameter is the dimensional size of the outside of the cylinder.

4.2.104.3 wall_thickness

The wall_thickness is the dimensional size from the outside surface to the inside surface.

4.2.104.4 schedule

The schedule is an optional specification of the wall thickness based on industry standard specified values.

4.2.105 Unidirectional_tape

Unidirectional_tape is a Stock_material_form for a Stock_material_composite that has the shape of a thin strip. The reinforcement fibers are running length-wise in the strip. The data associated with a

Unidirectional_tape are the following:

— thickness

— width

4.2.105.1 thickness

The thickness is the dimensional size of the top surface to the bottom surface. The thickness is the projected thickness that this material will fill in the final cured laminate.

4.2.105.2 width

The width is the dimensional size from one edge to the opposite edge.

4.2.106 Zone_structural_makeup

A Zone_structural_makeup describes the structural make-up of a particular zone, area, or point within a laminate.

NOTES

1 — Structural make-up information consist of 1) the smear material properties based on the one or more constituent(s) that reside in that zone or point; 2) the percentage of the total thickness within a zone or point that each constituent type makes up; and 3) the ordered list of physical constituents based on position within a zone or point. These three pieces of structural make-up information can co-exist in any order to describe a zone or point within a laminate.

2 — A single Zone_structural_makeup could apply to the whole part. If would be the case for a homogeneous_structural_part or a simple laminate of constant thickness and material constituents.

4.2.106.1 boundary

The boundary defines the shape of the zone_laminate_table as either a point, one or more unique list of curves, or a face. When boundary (zone_laminate_shape) is not defined for an instance of a zone_laminate_table, the zone_laminate_table applies to the whole part. This would be the case for a homogeneous_structural_part.

4.2.106.2 thickness

The thickness is the depth of the zone\area that the zone_laminate_table applies.

4.2.107 Zone_structural_makeup_shape_representation

A Zone_structural_makeup_shape_representation is the shape of a zone/area of a part.

NOTE — This zone can be a point, an specific area, or the entire part.

4.3 Application assertions

This subclause specifies the application assertions for the design through analysis of composite and metallic structures Application Protocol. Application assertions specify all relationships among application objects, the cardinality of the relationships, and the rules required for the integrity and validity of the application objects and UoFs. The application assertions and their definitions are given below.

4.3.1 Angularity_tolerance to Datum

Each Angularity_tolerance has a geometric reference defined by one, two, or three Datum. Each Datum defines a geometric reference for zero, one, or many Angularity_tolerance.

NOTE - An Angularity_tolerance is normally defined from one geometric reference. More that one may be used to define additional constraints on the tolerance.

4.3.2 Assembly_occurrence_located to Assembly_located

Each Assembly_occurrence_located defines an assembly occurrence in one Assembly_located. Each Assembly_located has one or many Assembly_occurrence_located.

4.3.3 Assembly_occurrence_located to Design_definition

Each Assembly_occurrence_located defines the component location in an Assembly_located of one Design_definition. Each Design_definition is a component of zero, one, or many Assembly_occurrence_located.

4.3.4 Assembly_occurrence_quantified to Assembly_quantified

Each Assembly_occurrence_quantified defines an assembly occurrence in one Assembly_quantified. Each Assembly_quantified has one or many Assembly_occurrence_quantified.

4.3.5 Assembly_occurrence_quantified to Design_definition

Each Assembly_occurrence_quantifed defines the component usages in an Assembly_quantified of one Design_definition. Each Design_definition is a component of zero, one, or many Assembly_occurrence_quantifed.

NOTE: Only one Assembly_occurrence_quantified may point to one Design_definition for the same Assembly_occurrence_quantified and effectivity.

4.3.6 Beveled_sheet_representation to Composite_sheet_representation

Each Beveled_sheet_representation has the surface and boundary defined by one Composite_sheet_representation. Each Composite_sheet_representation defines zero or one Beveled_sheet_representation.

4.3.7 Boundary_representation to Curves

Each Boundary_Representation has defining curves of one or many Curves. Each Curve is a defining Curve for zero, one or many Boundary_representation.

4.3.8 Change_notice to Approval

Each Change_notice has documentation of concurrence by one approval. Each Approval documents concurrence of zero or one Change_notice.

4.3.9 Change_notice to Part_version

Each Change_notice creates zero, one or many Part_version. Each Part_version is created by zero or one Change_notice.

NOTE- A Part_version is created by either a Change_notice or a Release_notice.

4.3.10 Change_notice to Release_change_item

Each Change_notice releases, modifies, deletes, or updates one or many Assembly_occurrence_located, Assembly_occurrence_quantified, Design_definition, Effectivity, or Toleranced_shape_model. Each Assembly_occurrence_located is released, modified, deleted, or updated by zero or Change_notice. Each Assembly_occurrence_located is released, modified, deleted, or updated by zero or Change_notice. Each Design_definition is released, modified, deleted, or updated by zero or Change_notice. Each Effectivity is released, modified, deleted, or updated by zero or Change_notice. Each Design_definition is released, modified, deleted, or updated by zero or Change_notice. Each Toleranced_shape_model is released, modified, deleted, or updated by zero or Change_notice.

4.3.11 Circular_runout_tolerance to Datum

Each Circular_runout_tolerance has a geometric reference zero or one Datum. Each Datum can be a geometric reference for zero, one, or many Circular_runout_tolerance.

NOTE- When a Circular_runout_tolerance does not have a geometric reference of a Datum, then appropriate portions of the Shape_aspect which this tolerance shall be used as the geometric reference.

4.3.12 Composite_layup_assembly to Composite_layup_assembly_shape

Each Composite_layup_assembly has its shape defined by one Advanced_b_representation, 3D_geometry_set, Facetted_b_representation, Manifold_surface_with_topology, Non_topologic_surface_and_wireframe, or Wireframe_with_topology. Advanced_b_representation defines shape of zero or one Composite_layup_assembly. Each 3D_geometry_set defines shape of zero or one Composite_layup_assembly. Each Facetted_b_representation defines shape of zero or one Composite_layup_assembly. Each Manifold_surface_with_topology defines shape of zero or one Composite_layup_assembly. Each Non_topologic_surface_and_wireframe defines shape of zero or one Composite_layup_assembly. Each Wireframe_with_topology defines shape of zero or one Composite_layup_assembly.

4.3.13 Composite_layup_assembly to Composite_layup_assembly_table

Each Composite_layup_assembly has one or many Composite_layup_assembly_table. Each Composite_layup_assembly_table defines the sequenced layup of one Composite_layup_assembly.

4.3.14 Composite_layup_assembly_table to Reinforcement_orientation_basis

Each Composite_layup_assembly_table has, as a basis for direction, one Reinforcement_orientation_direction. Each Reinforcement_orientation_direction is the basis for direction of one or many Composite_layup_assembly_table.

4.3.15 Composite_layup_assembly_table to Surface

Each Composite_layup_assembly_table is defined from one Surface. Each Surface defines the base surface for zero, one, or many Composite_layup_assembly_table.

4.3.16 Composite_layup_assembly_table to Composite_layup_sequence_definition

Each Composite_layup_assembly_table contains a sequence list of two or many Composite_layup_sequence_definition. Each Composite_layup_sequence_definition applies to one

Composite_layup_assembly_table.

4.3.17 Composite_layup_sequence_definition to Composite_constituent_part

Each Composite_layup_sequence_definition defines the sequence for assembly or bonding of one or many Ply, Ply_laminate, Filament_laminate, Processed_core, or Composite_layup_assembly. Each Ply has it's layup sequence defined by one Composite_layup_sequence_definition. Each Composite_layup_assembly has it's layup sequence defined by zero or one Composite_layup_sequence_definition. Each Filament_laminate has it's layup sequence defined by zero or one Composite_layup_sequence_definition. Each Processed_core has it's layup sequence defined by zero or one Composite_layup_sequence_definition. Each Ply_laminate has it's layup sequence defined by zero or one Composite_layup_sequence_definition.

NOTE - The same Composite_constituent_part can reside on the same sequence or layer. An example of that is when two identical small ply stacks are pre-kitted and placed on the layup at different locations within the same sequence or layer.

4.3.18 Conditioned_datum to Material_condition_modifier

Each Conditioned_datum is conditioned by one Material_condition_modifier. Each Material_condition_modifier conditions one or many Conditioned_datum.

4.3.19 Datum to Shape_aspect

Each Datum is defined by one Shape_aspect. Each Shape_aspect defines zero, one, or many Datums.

4.3.20 Design_definition to Approval

Each Design_definition is approved by one Approval. Each Approval approves zero, one, or many Design_definition.

4.3.21 Design_definition to Part_version

Each Design_definition is a definition of exactly one Part_version. Each Part_version is defined by one or many Design_definition.

4.3.22 Design_definition to Design_model

Each Design_definition has geometric features defined by zero, one, or many Design_model. Each Design_model defines geometric features of one Design_discipline_product_

definition objects.

4.3.23 Design_model to Geometric_model_representation

Each Design_model has a shape defined by one Geometric_model_representation. Each Geometric_model_representation is defining shape for zero or one Design_model.

4.3.24 Effectivity to Assembly

Each Effectivity is applied to one Assembly_occurrence_located or Assembly_occurrence_quantified. Each Assembly_occurrence_located has effectivity applied by zero, one, or many Effectivity. Each Assembly_occurrence_quantified has effectivity applied by zero, one, or many Effectivity.

4.3.25 Effectivity to Product_configuration

Each Effectivity is used for one Product_configuration. Each Product_configuration uses one or many Effectivity.

4.3.26 Filament_laminate to Filament_assembly

Each Filament_laminate is made from one Filament_assembly. Each Filament_assembly is stock material for one or many Filament_laminate.

4.3.27 Filament_laminate to Filament_laminate_shape

Each Filament_laminate has one Filament_laminate_shape. Each Filament_laminate_shape has zero, one, or many Filament_laminate.

4.3.28 Filament_laminate_shape to Boundary_representation

Each Filament_laminate_shape has its cross-sectional area defined by one Boundary_representation. Each Boundary_representation is a defining cross-sectional area for zero, one, or many Filament_laminate_shape.

4.3.29 Geometric_tolerance to Material_condition_modifier

Each Geometric_tolerance may be modified by one Material_condition_modifier. Each Material_condition_modifier modifies zero, one, or many Geometric_tolerance.

4.3.30 Geometric_tolerance to Shape_aspect

Each Geometric_tolerance defines the allowable variation in shape of one or many Shape_aspect. Each Shape_aspect has variation of shape defined by zero, one, or many Geometric_tolerance.

4.3.31 Geometric_sheet_representation to Surface

Each Geometric_sheet_representation has a basis surface of a Surface. Each Surface is a basis surface of zero, one or many 3D_Geometric_sheet_representation.

4.3.32 Geometric_sheet_representation to Boundary_representation

Each Geometric_sheet_representation has an outer boundary of one Boundary_representation and an inner boundary of a zero, one, or many Boundary_representation. Each Boundary_representation is boundary definition of one or many Geometric_sheet_representation.

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4.3.33 Linear_profile_tolerance to Datum

Each Linear_profile_tolerance has a geometric reference of zero, one, two or three Datums. Each Datum is a geometric reference for zero, one, or many Linear_profile_tolerance.

4.3.34 Manufacturing_plan to Manufacturing_plan_activity

Each Manufacturing_plan has activities define by one or many Manufacturing_plan_activity. Each Manufacturing_plan_activity is an activity for one Manufacturing_plan.

4.3.35 Manufacturing_plan to Design_requirement

Each Manufacturing_plan is designed to meet the requirments of one Design_definition. Each Design_definition is the requirment for zero, one, or many Manufacturing_plan.

4.3.36 Manufacturing_plan to Part_version

Each Manufacturing_plan is the plan for one Part_version. Each Part_version many have zero, one, or many Manufacturing_plan.

4.3.37 Manufacturing_plan_activity to Manufacturing_resource

Each Manufacturing_plan_activity has resources defined by zero, one, or many Manufacturing_resource. Each Manufacturing_resource is defined for one or many Manufacturing_plan_activity.

4.3.38 Model_least_material_condition to Geometry_model_representation

Each Model_least_material_condition defines the shape to be least material condition for one Geometry_model_representation. Each Geomtry_model_representation has least material condition defined by zero or one Model_least_material_conditon.

4.3.39 Model_location_tolerance

Each Model_location_tolerance defines the default location tolerance for one Geometry_model_representation. Each Geometry_model_representation has a default location tolerance defined by zero or one Model_location_tolerance.

4.3.40 Model_location_tolerance to Datum

Each Model_location_tolerance is defined with a geometric reference of one, two, or three Datums. Each Datum defines the geometric reference for zero, one, or many Model_location_tolerance.

4.3.41 Model_maximum_material_condition to Geometry_model_representation

Each Model_maximum_material_condition defines the shape to be least material condition for one Geometry_model_representation. Each Geomtry_model_representation has least material condition defined by zero or one Model_maximum_material_conditon.

4.3.42 Model_shape_tolerance to Datum

Each Model_shape_tolerance is defined with a geometric reference of one, two, or three Datums. Each Datum defines the geometric reference for zero, one, or many Model_shape_tolerance.

4.3.43 Model_shape_tolerance to Geometry_model_representation

Each Model_shape_tolerance defines the default shape tolerance for one Geometry_model_representation. Each Geometry_model_representation has default shape tolerance defined by zero or one Model_shape_tolerance.

4.3.44 Part to Company

Each Part has a design owner of one Company. Each Company is the design owner of zero, one, or many Parts.

4.3.45 Part_version to Part

Each Part_version is a version of one Part. Each Part has one or many Part_versions.

4.3.46 Ply to Orientation_angle

Each Ply has an orientation direction of zero or one Orientation_angle. Each Orientation_angle is orientation direction of zero, one, or many Ply_angle.

4.3.47 Ply to Ply_shape

Each Ply has one Ply_shape. Each Ply_shape can describe the shape of zero, one, or more plies.

4.3.48 Ply to Ply_Piece

Each Ply may but need not be made up of one or more Ply_pieces. Each Ply_piece can only be used within one ply.

NOTE - A Ply that is made up of only one Ply_piece can share the same shape representation with that one Ply_piece.

4.3.49 Ply_laminate to Ply_laminate_shape

Each Play_laminate has its shape defined by an Geometry_3d_set or Composite_sheet_representation. Each Geometry_3d_set defines shape of zero or one Ply_laminate. Each Composite_sheet_representation defines shape of zero or one Ply_laminate.

4.3.50 Ply_laminate to Ply_laminate_table

Each Ply_laminate has a table of one Ply_laminate_table. Each Ply_laminate_table is a table for one Ply_laminate.

4.3.51 Ply_laminate_table to Ply_laminate_sequence_definition

Each Ply_laminate_table has two or more layers or sequences defined by a Ply_laminate_sequence_definition. Each Ply_laminate_sequence_definition defines a layer or sequence of one or more Ply_laminate_table.

4.3.52 Ply_laminate_sequence_definition to Ply

Each Ply_laminate_sequence_definition must have one or more Ply. Each Ply may be associated with zero, one or many Ply_laminate_sequence_definition.

4.3.53 Ply to Ply_stock_material

Each Ply is made of stock material of one of Homogeneous_material, Filament_assembly, or discontinuous_fiber_assembly. Each Homogeneous_material can be stock material for zero, one, or many Ply. Each Filament_assembly can be stock material for zero, one, or many Ply. Each Discontinuous_fiber_assembly is stock material for zero, one, or many Ply.

4.3.54 Ply_piece to Ply_piece_shape

Each Ply_piece has its shape defined by one Tape_strip_representation or Ply_shape. Each Tape_strip_representation defines shape of one Ply_piece_shape. Each Ply_shape defines shape of zero, one, or many Ply_piece_shape.

4.3.55 Ply_shape to Composite_sheet_representation

Each Ply_shape has a shape defined by a Composite_sheet_representation. Each Composite_sheet_representation is a shape definition for one or many Ply_shape.

4.3.56 Ply_shape_type_flat_pattern to Ply_shape

Each ply_shape_type_flat_pattern is defined from one Ply_shape which is not a Ply_shape_type_flat_pattern. Each Ply_shape is defined by zero or one Ply_shape_type_flat_pattern.

4.3.57 Position_tolerance to Datum

Each Position_tolerance has a geometric reference of one, two, or three Datums. Each Datum is geometric reference to zero, one, or many Position_tolerance.

4.3.58 Processed_core to Core_shape

Each Processed_core has a shape definition of one Geometry_model_representation. Each Geometry_model_representation has zero, one, or many Processed_core.

4.3.59 Processed_core to Orientation_angle

Each Processed_core has a cell direction defined by zero or one Orientation_angle. Each Orientation_angle is defining cell direction for zero, one, or many Processed_core.

4.3.60 Processed_core to Ply

Each Processed_core has added material of zero, one, or many Ply. Each Ply is added material to zero, or one Processed_core.

4.3.61 Product_configuration to Part

Each Product_configuration is satisfied by zero, one or many Part. Each Part satisfies zero, one, or many Product_configuration.

4.3.62 Product_configuration to Product_model

Each Product_configuration is the configuration of exactly one Product_model. Each Product_model has one or many Product_configuration.

4.3.63 Release_notice to Approval

Each Release_notice has documentation of concurrence by one Approval. Each Approval documents concurrence of zero or one Release_notice.

4.3.64 Release_notice to Part_version

Each Release_notice creates one or many Part_version. Each Part_version is created by zero or one Release_notice.

NOTE- A Part_version is created by either a Release_notice or a Release_notice.

4.3.65 Release_notice to Release_release_item

Each Release_notice releases one or many Assembly_occurrence_located, Assembly_occurrence_quantified, Design_definition, Effectivity, or Toleranced_shape_model. Each Assembly_occurrence_located is released by zero or Release_notice. Each Assembly_occurrence_located is released, modified, deleted, or updated by zero or Release_notice. Each Design_definition is released by zero or Release_notice. Each Effectivity is released by zero or Release_notice. Each Design_definition is released by zero or Release_notice. Each Toleranced_shape_model is released by zero or Release_notice.

4.3.66 Shape to Shape_aspect

Each Shape of a part can be viewed as one or many Shape_aspects. A Shape_aspect is a portion of exactly one Shape.

4.3.67 Shape_aspect to Geometric_model_representation

Each Shape_aspect is represented by one or many Geometric_model_representation objects. Each Geometric_model_representation represents exactly one Shape_aspect.

4.3.68 Stock_amount to Design_definition

Each Stock_amount defines the engineering requirement for the quantity of material for the Design_definition. Each Design_definition has a quantity of material defined by zero, one, or many Design_definition.

4.3.69 Stock_amount to Stock_material

Each Stock_amount defines the quantity of material of one Stock_material. Each Stock_material has an amount defined by zero, one, or many Stock_amount.

4.3.70 Stock_material to Material_direction

Each Stock_material has one material direction. Each Material_direction has zero, one, or many Stock_material.

4.3.71 Stock_material to Stock_material_form

Each Stock_material has a material form defined by a Stock_material_form. Each Stock_material_form is definition of form for one or many Stock_material.

4.3.72 Stock_material to Material_specification

Each Stock_material has a specified material of one Material_specification. Each Material_specification can be the specified material for zero, one, or many stock_material.

4.3.73 Stock_material_composite to Stock_material

Each Stock_material_composite has the matrix material and reinforcement material defined by two Stock_material. Each Stock_material is the matrix material or reinforcement material for zero, one, or many Stock_material_composite.

4.3.74 Surface_profile_tolerance to Datum

Each Surface_profile_tolerance has a geometric reference of zero, one, two, or three Datum. Each Datum is a geometric reference for zero, one, or many Surface_profile_tolerance.

4.3.75 Surface_texture to Geometry_model_representation or Shape_aspect.

Each Surface_texture defines the allowable surface irregularities of surfaces defined by a Geometry_model_representation or Shape_aspect. Each Shape_aspect has surface irregularities defined by

zero or one Surface_texture. Each Geometry_model_representation has surface irregularities defined by zero or one Surface_texture.

4.3.76 Symmetry_tolerance to Datum

Each Symmetry_tolerance has a geometric reference of one Datum. Each Datum is geometric reference for zero, one, or many Symmetry_tolerance.

4.3.77 Zone_laminate_table to Composite_layup_assembly or Ply_laminate

Each Zone_laminate_table defines the layup sequence for a particular section of a Composite_layup_Assembly or Ply_laminate. Each Composite_layup_assembly has its layup sequence defined by zero, one, or many Zone_laminate_table. Each Ply_laminate has its layup sequence defined by zero, one, or many Zone_laminate_table.

4.3.78 Zone_laminate_table to Zone_shape

Each Zone_laminate_table defines the layup sequence for a Shape_aspect. Each Shape_aspect is defined by zero or one Zone_laminate_table.

4.3.79 Zone_laminate_table to Zone_component

Each Zone_laminate_table is an ordered list of the components of eitheirt a Ply, Filament_laminate, or Processed_core. Each Ply is in the ordered list of zero, one, or many Zone_laminate_table. Each Filament_laminate is in the ordered list of zero, one, or many Zone_laminate_table. Each Processed_core is in the ordered list of zero, one, or many Zone_laminate_table.

4.3.80 Zone_laminate_table to Reinforcement_orientation_basis

Each Zone_laminate_table has the material direction basis defined by one Reinforcement_orientation_basis. Each Reinforcement_orientation_basis defines directions for zero, one, or many Zone_laminate_table.

Annex F
(informative)

Application activity model

The application activity model (AAM) is provided to aid in the understanding the scope and information requirements defined in this application protocol. The model is presented as a set of definitions of both the activities and the associated data via a set of activity diagrams. It covers activities which go beyond the subject of this application protocol. The definitions given in this annex do not supersede the definitions given in the normative text.

The diagrams were developed from a composites structural part definition perspective due to the nature of the application protocol, would be considered to be inclusive of homogenous material structural parts (e.g. metallics). This is due to the fact that composite structural part definitions typically have more extensive definitional requirements than homogenous material structural part definitions. This perspective can be seen in many of the lower level IDEF0 diagrams where composites are split from homogenous material definitions.

The diagrams were also developed from an aerospace manufacturer perspective to help to bound the AAM and the scope of the AAM activities. It is perceived that the activities for the AAM for a military aerospace manufacturer are more strict than most industrial drawing practices and are more encompassing than most commercial drawing preparation requirements. It is the intent to use composite parts to validate the AAM and the AP since homogenous material structural parts are considered a subset of composite structural parts for purposes of presentation in a drawing and development in a model.

The PAS-C Program is building a suite of application protocols to support the exchange of product data within the realm of the life cycle of a product. The AP development activity has been approached in an integrated manner that has decomposed the problem from a high level perspective and then selected several areas that have a high payback potential for development. This AAM is representative of one of these areas and is a decomposition for drawings and the requirements for drawings. The original overall AAM for all the PAS-C APs is given in [16]. From the original overall AAM, there has been some refinement at the higher level and there has been some generalization at the lower levels to accommodate the aspect of homogenous material parts since they are considered a subset of the total realm. There has also been some generalization on the lower levels relative to the types of composite parts of interest.

F.5 AAM Diagrams

In the following diagrams, activities which are out of scope are marked as dashed boxes. Data flows which are out of scope are marked as dashed lines. At the higher levels of the IDEF0 diagrams, it must be noted that if an activity or data flow is marked as in-scope, it doesn't guarantee that all data within that activity or data flow is in scope. The decomposition of the activity and data flow in the lower level

activities will clarify the intent. This AP is interested in data and not in the activity involved in creating the data or in using the data. In other words, the actual activity is not part of the AP, the data that is used in the activity or created by the activity are what the AP has an interest in.

6 AAM Abbreviations

AAM	Application Activity Model
AMR	Advanced Material Requests
AP	Application Protocol
CDR	Critical Design Review
CSP	Composite Structural Part
DoD	Department of Defense
GD	General Dynamics
I/F	Interface
IML	Inner Mold Line
M/D/B/S	Manage/Design/Build/Support
M&P	Materials & Processes
OML	Outter Mold Line
PAS-C	PDES Application Protocol Suite for Composites
PDES	Product Data Exchange using STEP
QA	Quality Assurance
SP	Structural Part
STEP	STandard for the Exchange of Product model data

A0: Develop, Procure, Build, Use & Maintain a Structural Part

Activities:

A1 Develop Structural Part Needs & Procurement

This activity is the Customer analysis of the Structural Part needs based on the customer's needs and the state of Structural Part technologies, along with the procurement process throughout the life cycle as managed by the Customer.

A2 Manage, Design, Build and Support a SP

This activity consists of all the contracted management of resources, design, build, and support of a typical Structural Part, as done at the prime contracting company.

A3 Use & Maintain a SP

This activity is the Customer's use and maintenance of a Structural Part. It also includes repair, redesign, and modification activities of a Structural Part at the servicing location.

A4 Develop & Provide SPs Materials

This activity is the material suppliers process of creating stock material for composite and homogenous material manufacturers. Basic material properties and allowables are addressed here.

Inputs:

I1 SP Design History

C2 SP Structural Interfaces

These are all the structural interfaces tha

C3 Structural Part Product Dev. &

These techniques consist of Structural P Material Development Techniques.

- Structural Part Product Dev.

  The standard product develo design, analysis, and build pr

- Structural Part Maintenance

  These are the Maintenance T

- Structural Part Material Dev

  These are the Material Devel material suppliers.

Outputs:

O1 Used SP

This is the Structural Part as a result of u

Mechanisms:

(None)

The Structural Part design history consists of all the similar design activities that have created data that is similar to the Structural Part.

I2 Procured Structural Parts & Information

These are the as-built Structural Parts and Information as purchased from the outside associate or subcontractors. It includes not only the procured parts, but the respective drawings, material information such as stock, material properties, etc.

Controls:

C1 Product Dev. Standards

These are the standard aerospace product development standards that apply to Structural Part. Irrespective of composition of Structural Part.

Process Interactions:

- Structural Part

  This is the as-built Structural Part development.

- SP Prelim. Sys. Descr.

  The preliminary Structural Part system description consists of the business, design, build and logistics system description.

- SP Raw Materials & Materials Properties

  All of the raw materials as received from the material supplier. These are for the item(s) of the Structural Part. It includes the properties of the materials, as well as, the rough material: stock.

- SP Product Dev. Info.

  The Structural Part product development information consists of the business management, design, definition package and of logistics support parts for the Structural Part.

- Field and Maintenance Changes & Revision History

  These are the reviewed field/maintenance changes that result from in field use of the Structural Part and the history of these changes in field.

- SP Contract

This is the contract for the Structural Part development as received from the customer.

- Material Specs & Reqs

  Definition of material composition, form and performance reqruiements along with orders procuring material.

INSERT DIAGRAM A2

A2: Manage, Design, Build and Support a Structural Part

Activities:

A21 Manage a SP Development

These activities involve managing all the resources specific to the Structural Part through the design, build and support functions. This includes people, budgets, tools, materials, etc.

A22 Design and Analyze a SP

This activity involves the complete design and analysis life cycle from the pre-proposal phase to product support in the field.

A23 Build and QA a SP

The conversion of a design into a finished product and quality assurance functions that assure that the product meets requirements. This is usually a repetitive function, continuing substantially throughout the product's life cycle. It receives the design from design functions and outputs the products, spare and repair parts, and technical data on each instance of the product.

A24 Support Logistics of a SP

This activity involves the logistics engineering, reliability and maintainability design studies, technical and maintenance documents, spares and training systems that the Structural Part repairs.

Inputs:

I1 SP Prelim. System Descr.

The preliminary Structural Part system description consists of the

- SP Prelim. Build System De
  The Structural Part prelimina
  system view of the manufact
  support the Structural Part. p
- SP Preliminary Logistics Sys
  The Structural Part prelimina
  system view of the relationsh
  reliability and maintainabilit
  preliminary Structural Part d

I2 SP Design History

The Structural Part design history consis
have created data that is similar to the St

I3 Procured Structural Parts & Info

These are the as-built Structural Part and
associate or subcontractors.

- Procured SP
  This consists of the actual pr
- Procured SP Info
  This is the information that i
  would include the product de

business, design, build and logistics system description.

- SP Prelim. Bus. System Descr.
  The Structural Part preliminary business system description contains the system relationships of the budget, schedule and costs of a preliminary Structural Part.

- SP Prelim. Design Sys. Descr.
  The Structural Part preliminary design system description shows the functional, geometrical and fit-up of a preliminary Structural Part using a graphical/textual system engineering language.

I4

SP Raw Materials & Material P

All of the raw materials as received from
item(s) of the Structural Part. It include
the rough material: stock.

- SP Material Properties
  This consists of the material

- SP Raw Material
  This is the actual raw materi

I5 Field & Maintenance Changes & Revision History

These are the reviewed field/maintenance changes that result from in field use of the Structural Part and the history of these changes in the field.

Controls:

C1 SP Contract

This is the contract for the SP development as received from the customer.

C2 SP Structural Interfaces

These are all the structural interfaces that mate with the Structural Part.

Outputs:

O1 Structural Part

This is the as-built Structural Part

- Tested SP Prototypes
  The tested Structural Part prototypes consist of all the pre-production physical or electronic models of the Structural Part that have been tested.

O2 SP Product Dev. Info

The Structural Part product development information consists of the business management, design, definition package and logistics support

- SP As-Built Definition Packa
  This consists of the as-built c
  Structural Part.

Mechanisms:

(None)

Process Interactions:

- SP Budget & Schedule
  This the Structural Part budg
- SP Producibility & Log
  This consists of the as-built c
  Structural Part that must be i
  designed Structural Part.
- SP Prototypes
  The Structural Part prototype
  or electronic models of the S
- Tested SP Prototypes
  The Tested Structural Part pr
  physical or electronic models
- SP Support Logistics D

parts for the Structural Part.

- SP Bus. Mgmt. Data
  This consists of all the budget, cost, schedule and people use data for the Structural Part development. This also includes information such as contract number, design activity, etc.

- SP Design Data
  Structural Part design data consists of all the configuration managed design and analysis information that occurs for preliminary, detail and production support phases of the Structural Part.

- SP Support Logistics Data
  This Structural Part support logistics data consists of all the logistics engineering, reliability and maintainability, technical and maintenance, documents and spares data needed to support the Structural Part.

This Structural Part support l
engineering, reliability and m
documents and spares data n
includes any required change
documentation of the design
can be achieved.

- Anomly Reports
  Reports analyzing the rejecti
  and production planning.

A22: Design and Analyze a SP

Activities:

A221 Collect, Review, Define & Distribute Structural Part Reqs.

This activity involves collecting, reviewing, defining and distributing structural, cross-functional engineering, build, QA and logistic support requirements of the Structural Part.

A222 Conduct Structural Part Prelim. Design & Analysis

This activity consists of the preliminary design and analysis of various Structural Part concepts in order to trade performance, cost and producibility parameters for selecting an optimum Structural Part concept.

A223 Perform Structural Part Detail Design & Analysis

This activity involves testing the selected preliminary Structural Part design concept and developing it in sufficient detail to meet the desired performance, cost and production goods.

A224 Perform Structural Part Prod. Design & Analysis Support

This activity involves supporting all the design and analysis needed to resolve the changes encountered in manufacturing and/or those from in field use of the Structural Part.

A225 Conduct Structural Part Prototype Tests & Eval.

This activity involves all the physical and electronically simulated tests and evaluation of Structural Part prototypes.

I2 SP Design History

The Structural Part design history consis
have created data that is similar to the St

I3 SP Materials Properties

This consists of the material properties c

I4 SP Produce & Log Data & Buil

The Structural Part produce and logistic
manufacturing maintainability and in-fie
Part. Build changes are these manufactu
Structural Part.

- SP Producibility & Log Data
  The Structural Part producib
  various manufacturing, main
  studies done for the Structura
- SP Build Changes
  Structural Part build changes
  production process of the Str

I5 Field & Maintenance Changes &

Field Maintenance changes are the revie
from in field use of the Structural Part a

I6 SP Prototypes

The Structural Part prototypes consist of

A226 Manage Config. of Structural Part Data

This activity involves the configuration management of all the data produced in the design development of the SP.

Controls:

models of the Structural Part.

Inputs:

(None)

I1 SP Preliminary Design Sys. Descr.

The Structural Part preliminary design system description shows the functional, geometrical and fit-up of a preliminary design of a Structural Part using a graphical/textual system engineering language.

Outputs:

O1 Tested SP Prototype

The tested Structural Part prototype consists of the performance loaded physical or simulated Structural Part.

O2 SP Design Data

Structural Part design data consists of all the configuration managed design and analysis information that occurs for preliminary, detail and production support phases of the Structural Part.

- Config Data

  This is the configuration of the Structural Part.

Mechanisms:

(None)

Process Interactions:

- Prelim. Funct. Reqs.

  These are the preliminary functional structural Part requirements.

- Selected SP Prelim. Des.

  The Structural Part preliminary design selected from the various concepts that were traded, is now ready for the detail

- Pre-Rel. SP Prelim. Da

  This is the pre-released Struc data.

- Pre-Rel. SP Detail Dat

  This is the pre-released Struc

- Prelim. SP Test Reqs.

  These are the preliminary Str preliminary design and analy

- Detail SP Test Reqs.

  These are the detail Structura preliminary detail and analys

- Pre-Rel. SP Design Da

  This is the pre-released prod the Structural Part.

- Approved SP Reqs.

  These are the functional and reviewed to be specific to a S performance constraints of th features that are desired. The Design, Build and Support ac

design phase.

- SP Test Data

  All of the Structural Part test data from the structural verification test of the Structural Part and its subcomponents.

- Prelim. Des. Reqs. Chgs.

  The preliminary design requirements changes based on the analysis, producibility and maintainability results.

- Detail Des. Reqs. Chgs.

  The detail design requirements changes based on the analysis, producibility and maintainability results.

- Field/Maint. Changes

  These are the reviewed field/
  field use of the Structural Pa

- Approved SP Data

  These are the functional and
  data that have been reviewed
  include the technical perform
  along with the envelope featu
  are from the Manage, Design

Insert Node A2233332 Prepare Detail SP Item Drawings

Insert Node A223233223 Create SP Data

A223233223: Create SP Data

Activities:

A2232332231 Prepare SP Composite Details

This is the preparation of all the Structural Part Composite Details to resolve the periphery, thickness, layup orientation and ply stack-up.

A2232332232 Prepare CSP Core Details

This is the preparation of all the Composite Structural Part core details to resolve the core periphery, thickness, density, material, transition and ribbon features.

A2232332233 Prepare SP Homogenous Material Details

This is the preparation of all the Homogenous Structural Part details to resolve the periphery, thickness, density, material, and transition features.

Inputs:

I1 Selected SP Views

The selected Structural Part views consist of the respective top, front, and side views of the Structural Part.

- CSP Details Views
  The Composite Structural Part Details Views are the various selected views necessary to show the desired features of the composite item details. These include the typical front, top and side views.

- CSP Core Views
  The Composite Structural Part Core Vie
  necessary to show the desired features o
  include the typical front, top and side vi

- Homogenous SP Views
  The Homogenous Structural Part Views
  necessary to show the desired features o
  typical front, top and side views.

I2 SP Layouts & Models

The Structural Part layouts consist of all the two of the design. The Structural Part models consis required of the design.

- CSP Details Layouts & Models
  The Composite Structural Part Details la
  dimensional geometry required of the de
  models consist of the appropriate geome

- CSP Core Layouts & Models
  The Composite Structural Part Core layo
  dimensional geometry required of the de
  Part core models consist of the appropri
  design.

- Homogenous SP Layouts & Models

The Homogenous Structural Part layouts consist of all the two dimensional geometry required of the design. The Homogenous Structural Part models consist of the appropriate geometry required of the design.

I3 Collected SP Baseline Drawing Data

This collected Structural Part baseline drawing data consists of all the drawing data from the selected Structural Part preliminary design, test data and producibility and maintainability studies.

Controls:

C1 SP Interface, Joint, Size, and Design Constraints

The Structural Part interfaces, joints and size constraints are from the various mating parts envelope and joint configuration along with the overall size and design constraints.

Outputs:

O1 SP Details

Structural Part details consist of all the design data for the Structural Part.

- CSP Details

  These are the details of the Composite Structural Part Details as designed to meet the design requirements. This includes the skin periphery, thickness, lay-up orientation and ply stack-up.

- CSP Core Details

  The Composite Structural Part core deta
  thickness, density, internal, transition an

- Homogenous Mtl. SP Details

  The Homogenous Material Structural Pa
  data for the periphery, thickness, density

Mechanisms:

(None)

Process Interactions:

- CSP Filler, Cap, & Core Periph

  The Composite Structural Part Filler, Ca
  the filler, cap and core periphery, thickn
  and ribbon features.

- CSP Core Periphery

  This is the Composite Structural Part Co
  skin, mating part, and tooling requireme

- CSP Filler & Cap Periphery

  This is the Composite Structural Part Fi
  dictated by core, mating part, and toolin

FIGURE A23

A23: Build & QA an CSP

Activities:

A231 Plan For Manufacture

Translate Engineering product data into manufacturing plans including major assembly breaks, sub-assembly breaks, major tools, facilities, and equipment requirements, as well as make-buy plans.

A232 Develop Production Plan

Translate the overall strategy plans (developed in A1) into specific build activity definition suitable for shop floor workers.

A233 Provide Tools

Perform the tasks required to design, build, and control configuration of tools defined in A1 & A3.

A234 Procure Manufacturing Materials

Obtain all materials required to produce CSP. This includes receiving, inspection, certification, and storage.

A235 Produce Product (CSP)

The composite details are produced and assembled into the correct structure. Each step is completed and then inspected to ensure that the CSPs produced meet the design requirements.

A236 Ship Product

When the part is complete it must be transported to the major assem or the customer, in a manner that prevents any damage to the part.

Inputs:

I1 Design Data

Information that conveys the part design to manufacturing. Includes material requirements, engineering drawings, etc.

I2 Raw Materials & Procured Parts

All material that are required to procure an CSP. This includes, but to, all prepregs, core, potting compounds, adhesives, bagging mate supplies and any parts supplied by a vendor or internal detail fabric

I3 SP Prelim Build System Descr

The description of the production capability nessary to build compo

Outputs:

O1 CSP & As-built Definition Package

An CSP and the accompanying information package that defines th customer.

O2 SP Producibility Data & Build Change Requests

Feedback of production requirements including requests to make m

the build data.

O3 Anomaly Reports

All information regarding a part or process that does not fall within accepted limits or may be improved or modified. This includes, but is not limited to, incomplete operation reports, discrepancy reports, requests for engineering investigations, request for planning changes, and requests for changes to tooling.

O4 Material Requirements

Order for materials, parts, etc. to be purchased from outside the organization.

Controls:

Mechanisms:

Process Interactions:

Composite Part Mfg. Procedures

Documented approach showing how the CSP will be manufactured.

Mfg BOM

A complete manufacturing indentured part list including all the parts and sub-parts as seen by manufacturing. This parts list corresponds to manufacturing needs for segregation of work to production orders. This includes requirements for procured materials.

Manufacturing Plan

Information detailing the tools, processes, and material forms that will be used to build the desired CSPs.

Shop Floor Work Instructions

Documentation containing the shop floor authorization to perform t
detail planning, and any documentation required to identify any pla
operational deviations.

Raw Materials & Procured Parts

All material that are required to procure an CSP. This includes, but
to, all prepregs, core, potting compounds, adhesives, bagging mate
supplies and any parts supplied by a vendor or internal detail fabric

Tools

The part specific equipment required to produce a part. This includ
limited to, computer hardware/software, NC programs, production
inspection equipment, material handling devices, and hand tools.

NC Programs

A set of machine instructions written in a appropriate language whi
intended to control a machine for a manufacturing activity.

FIGURE A231

A231: Plan For Manufacture

Activities:

A2311 Assume a Structure & Method of Manufacturing

Establish production breaks, Major Unit configurations, & major subassemblies, make tentative make or buy decisions and a tooling & assembly overall plan. For a CSP, this activity is normally performed concurrently with design.

A2312 Develop Fabrication Requirements

Estimate resource needs, cost to purchase or make, and timing to start-up and production.

A2313 Develop Support Activity Plans

Develop a top level plan of production for QA, Materials, and other support areas.

A2314 Develop/Certify Manufacturing Materials & Processes

Develop a fabrication procedure which produces products conforming to engineering material process specifications. Include certification of the process.

A2315 Determine Detail Method Of Manufacturing

Define a manufacturing bill of materials (BOM) and for each item of that BOM. Define a manufacturing method and vendor purchase plan.

Inputs:

I1 SP Prelim Build System Descr

The description of the production capability nessary to build compo

I2 Build System Description

The "as-built" configuration of a product. Includes certification of r processes, part inspection results, rework/repair operations, and ver production/inspection steps.

I3 Design Data

Information that conveys the part design to manufacturing. Includes material requirements, engineering drawings, etc.

Outputs:

O1 Manufacturing Plan

Information detailing the tools, processes, and material forms that w build the desired CSPs.

O2 Mfg BOM

A complete manufacturing indentured part list including all the part parts as sen by manufacturing. This parts list corresponds to manufa for segregation of work to production orders.

O3 Composite Part Mfg Procedures

Documented approach showing how the CSP will be manufactured

O4 Material Specifications & Allowables

Definition of material composition, form and performance requirements.

O5 Engineering Change Request

Document requesting Engineering to investigate and/or correct any design deficiencies that the CSP difficult or impossible to build.

O6 Composite Part Mfg Procedures

Definition of the required steps to fabricate an CSP.

Controls:

Mechanisms:

Process Interactions:

Fabrication Requirements

Definition of the required steps to fabricate an CSP.

New/Certified Manufacturing Methods

Any manufacturing methods that have been given official approval for production use.

Selected Manufacturing Approach

Definition of the fabrication method at a very general level.

FIGURE A2315

A2315: Determine Detail Method Of Manufacturing

Activities:

A23151 Complete Manufacturing Parts List

The parts list per the manufacturing breakdown is completed.

A23152 Determine Make/Buy

Whether to make or buy the CSPs on the parts list is determined based upon program parameters, CSP complexity, and economic factors.

A23153 Determine Precise Form Of Sub-Parts

Determine the form of sub-parts (e.g., forged, cast, sheet stock, etc.). that will provide the most economical production of an CSP that meets all design requirements. The form of sub-parts may change during the life cycle of a program.

Inputs:

I1 New/Certified Manufacturing Methods

Any manufacturing methods that have been given official approval for production use.

Outputs:

O1 Mfg BOM

A complete manufacturing indentured part list including all the part parts as sen by manufacturing. This parts list corresponds to manufa for segregation of work to production orders.

O2 Fabrication Plan

A plan describing the fabrication approach for each part to be built organization.

Controls:

(None)

Mechanisms:

(None)

Process Interactions:

Parts List

A listing of the part identifying numbers.

Production Part Requirements

Defines what CSPs must be produced and when in order to meet de schedules.

FIGURE A232

A232: Develop Production Plan

C1 **Activities:**

A2321 Develop Bonding/Composite Work Instructions

Define the detail of the assembly and manufacturing methods and sequence such that it can be released to the shop.

A2322 Develop Support Process Plans

Define Plans for support activities such as materials, quality assurance, tooling, facilities, equipment, and personnel.

A2323 Control, Validate, & Release Planning

Perform the administrative and managerial tasks necessary to assure that the planning is current with engineering definition and properly approved for production.

Inputs:

I1 Design Data

Information that conveys the part design to manufacturing. Includes part lists, material requirements, engineering drawings, etc.

I2 Anomaly Reports

Reports analyzing the rejection of production parts for feedback to design & production planning.

Outputs:

O1 Shop Floor Work Instructions

Documentation containing the shop floor authorization to perform t detail planning, and any documentation required to identify any pla operational deviations and the Production Plan.

Controls:

C1 Composite Part Mfg. Procedures

Documentation showing the required steps that must be followed in correctly perform an activity. Also shows allowed deviations.

C2 Manufacturing Plan

Information detailing the tools, processes, and material forms that w build the desired CSPs.

C3 Mfg BOM

A complete manufacturing indentured part list including all the part parts as sen by manufacturing. This parts list corresponds to manufa for segregation of work to production orders.

Mechanisms:

(None)

Process Interactions:

Work Instructions

Detail instructions on how work is to be performed including routing, specifications to control the work, and a complete definition of what is to be accomplished at each production step. Also includes manufacturing documentation requirements.

Support Process Plans

Detail instructions for manufacturing support activities such as quality assurance, inspection, and testing. It also includes sequencing & routing information in relation to other process plans.

FIGURE A2321

A2321: Develop Process Plans

Activities:

A23211 Conduct Preplanning Review

Review planned approach versus manufacturing procedures to create the next level detail of fabrication plan.

A23212 Develop other Tool Requirements

Define tool requirements in addition to major tools defined earlier such as ply location or cutout templates, nc programs for cutout or trim, and tape laying nc programs.

A23213 Develop Build Sequence

Define fabrication steps necessary to build the part and define these in instructions suitable for shop floor use.

A23214 Audit and Verify Planning

Review of the work instructions to verify clarity, conformance to procedures, and ability to produce the required part.

A23215 Provide Modification Planning

Plan the rework of existing parts to meet design changes and /or to make rejected parts meet design requirements.

Inputs:

I1 SP Design Data

Information that conveys the part design to manufacturing. Includes material requirements, engineering drawings, etc.

I2 Composite Part Mfg Procedures

Approved methods of manufacturing composite parts which will co design specifications.

Outputs:

O1 Work Instructions

Detail instructions on how work is to be performed including routin specifications to control the work, and a complete definition of wha accomplished at each production step. Also includes manufacturing documentation requirements.

Controls:

C1 Manufacturing Plan

Information detailing the tools, processes, and material forms that w build the desired CSPs.

C2 Mfg BOM

A complete manufacturing indentured part list including all the part parts as sen by manufacturing. This parts list corresponds to manufa for segregation of work to production orders.

C3 Composite Part Mfg Procedures

Approved methods of manufacturing composite parts which will conform to design specifications.

Mechanisms:

(None)

Process Interactions:

Planning Approach

The fabrication approach as refined during preplanning.

Tool Requirements

Documentation of the need for a tool for fabrication.

FIGURE A233

A233: Provide Tools

Activities:

A2331 Design Tools

Provide engineering definition of tools.

A2332 Develop NC Programs

Provide the Numerical Control Programs needed to fabricate tools.

A2333 Fabricate/ Rework Tools

Make and/or refurbish tools.

A2334 Provide Liaison Support

Support tool fabrication and tool tryout in production by providing expertise and resolution of problems.

Inputs:

Design Data

Information that conveys the part design to manufacturing. Includes part lists, material requirements, engineering drawings, etc.

Problem Reports

All information regarding a part or process that does not fall within accepted limits or may be improved or modified. This includes, but is not limited to, incomplete operation reports, discrepancy reports, requests for engineering investigations, request for planning changes, and requests for changes to tooling.

Outputs:

O1 Tools

Manufacturing aids used to build an CSP.

O2 NC Programs

A set of machine instructions written in a appropriate language whi

intended to control a machine for a manufacturing activity.

O3 Problem Resolution

Information describing what action must be taken in order to resolv

problem.

Controls:

C1 Manufacturing Plan

Information detailing the tools, processes, and material forms that w

build the desired CSPs.

C2 Mfg BOM

A complete manufacturing indentured part list including all the part

parts as sen by manufacturing. This parts list corresponds to manuf

for segregation of work to production orders.

Mechanisms:

(None)

Process Interactions:

Tool Orders

Request that tooling operations be completed either to rework or fabricate a tool required to build an CSP.

NC Programs

A set of machine instructions written in a appropriate language which are intended to control a machine for a manufacturing activity.

FIGURE A2331

A2331: Design Tools

Activities:

A23311 Generate Design Criteria

Conduct a tooling producibility review which creates a design criteria and a request to design a tool.

A23312 Conduct Conceptual Tool Design

Determine the approach to be used for the tool design, including supporting structure type, rigidity required, transportability requirements, autoclave loading and heating requirements, and bagging and pull-down requirements.

A23313 Perform Detail Tool Design

Complete the detail definition of the tool design, including presentation of the design in suitable format.

A23314 Review & Approve Tool Design

Validate Tool Design fit, form, & function . Validate tool design to product design. Release tool design to manufacture.

Inputs:

I1 Design Data

Information that conveys the part design to manufacturing. Includes part lists, material requirements, engineering drawings, etc.

I2 Problem Resolution

Information describing what action must be taken in order to resolv problem.

Outputs:

O1 Tool Orders

Request that tooling operations be completed either to rework or fal required to build an CSP.

Controls:

C1 Mfg BOM

A complete manufacturing indentured part list including all the part parts as sen by manufacturing. This parts list corresponds to manufa for segregation of work to production orders.

C2 Manufacturing Plan

Information detailing the tools, processes, and material forms that w build the desired CSPs.

Mechanisms:

(None)

Process Interactions:

Tool Design Criteria

A definition of the role the tool must perform in the manufacturing cycle and the corresponding parameters the tool must meet in order to fill that role. Includes life expectancy and general functionality.

Conceptual Design

Definition of the general capabilities of the design. Usually defines material and support structure type.

Tool Design

A definition of the tool for manufacturing. Includes life expectancy and general functionality.

A2332

A2332: Develop NC Programs

Sub-Activities:

A23321 Provide Production & Tooling NC Programs

Develop and Debug NC programs to perform inspection operations (inspect tool designs and CSPs), and perform fabrication operations (CSPs and tools).

A23322 Control NC Programs

Provide serialized identification and validate the configuration of the program for the desired application.

A23323 Proof NC Programs

Schedule NC proofing and validate Tool NC program by simulation or on machine.

A23324 Release NC Programs

Transfer NC media to tool Fabrication Storage.

Inputs:

I1 Design Data

Information that conveys the part design to manufacturing. Includes part lists, material requirements, engineering drawings, etc.

I2 Problem Resolution

Information describing what action must be taken in order to resolve a given problem.

Outputs:

O1 NC Programs

A set of machine instructions written in a appropriate language whi intended to control a machine for a manufacturing activity.

Controls:

C1 Tool Orders

Request that tooling operations be completed either to rework or fabricate a tool required to build an CSP.

C2 Mfg BOM

A complete manufacturing indentured part list including all the parts and sub-parts as sen by manufacturing. This parts list corresponds to manufacturing needs for segregation of work to production orders.

C3 Manufacturing Plan

Information detailing the tools, processes, and material forms that will be used to build the desired CSPs.

Mechanisms:

(None)

Process Interactions:

Annex M
(informative)

Bibliography

The following are general informative references:

[1] Guidelines for the Development and Approval of STEP Application Protocols (Palmer and Gilbert),

[2] Supplementary Directives for the Drafting and Presentation of ISO 10303 (Burkett, Nettles, Shaw, Wellington and Palmer),

For this document, the following are specific informative references:

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